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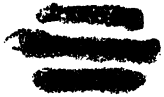

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PLANTING.

THE subject of planting may, with propriety, be divided into three parts: useful or forest-tree planting, ornamental or garden planting, and orchard or fruit-tree planting. Each of these divisions of the subject, from its importance and interest, in a national point of view, as well as to individuals, seems to demand a distinct treatise.

The first of these, forest-tree planting, is proposed for the subject of the following pages; and the details of the theory and practice of the art discussed under the following heads:

I. Of some of the advantages resulting from judicious planting.

II. Of the structure of trees; and of the natural agents which influence and govern the growth of the plant from the period of germination to its full maturity. Of the seeds of forest-trees; and of the processes of vegetation.

III. Of the different modes of rearing forest-trees:—by sowing the seeds on the spot where they are to remain for timber; of sowing the seeds on nursery beds, and afterwards transplanting the young plants to their timber sites; by preserving and training proper shoots or suckers, produced by coppice roots or stools. Comparative advantages and disadvantages of these different modes. Of simple and of mixed plantations.

IV. Of the soils and sites most profitably employed in the growth of timber. Intimate nature of the different soils peculiarly adapted for the growth of particular species of forest trees.

V. Of the most approved modes of preparing different soils for the reception of the plants: fencing, draining, ploughing, trenching. Of the formation of rides or carriage-ways into the interior of plantations. Of the best mode of covering these with herbage.

VI. Of the culture of plantations: soil, pruning, thinning. Remedies for accidental injuries, and natural diseases of forest-trees. Seasons for felling trees. Of the tannin in the bark of different species of trees.

VII. Of the progressive increase of the size or produce of wood in different species of trees. Of the mode of valuing plantations: present value; prospective value. Of the products of plantations. Of some individual trees which have attained to great perfection. Of the terms used to denote certain products of plantations.

VIII. An enumeration of the different species: those of large growth, those of under growth for copse wood, ornament, or shelter. The generic botanical characters. Their natural soils; mode of propagation; and the uses to which their timber is more generally applied.

Chapter I.

Of some of the Advantages resulting from judicious Planting.

Judicious planting and the skilful culture of plantations combine national and private interests in an eminent degree; for, besides the real or intrinsic value of the timber or ostensible crop, with other produce of woods, available for the arts and comforts of life, judicious forest-tree planting improves the general climate of the neighbourhood, the staple of the soil, as regards the gradual accumulation of vegetable matter, affords shelter to live stock, promotes the growth of pasture and of corn crops, beautifies the landscape, and thus greatly and permanently increases the value of the fee simple of the estate and adjoining lands.

If we turn to those soils emphatically termed wastes—exposed, elevated lands, moors, bogs, and sterile sands—composing so large a portion of the British empire, and naturally clothed by the lowest and least valuable products of the vegetable kingdom, the inferior grasses, mosses, rushes, sedges, ferns, and heaths—we find that upon them the more valuable domestic animals cannot exist. If we consider the reason why they are so barren, waste, and unproductive, when compared with other lands not more favoured by nature, and under similar circumstances of latitude and elevation, the cause will, in many instances, be found in the want of the shelter and shade of trees, and of the ameliorating influence which plantations exercise on ungenial local climates.

The essential, permanent pasture grasses cannot be established on naked exposed situations; but when assisted by the shelter of forest-trees they become permanent and productive. Plantations supply us with with fuel, with materials for fencing, enclosing, building; corn crops, soiling plants, and root crops are obtained in succession under their genial protection. Many thousands of acres now unprofitable to the owners and to the community, might, by judicious planting, be reclaimed, and rendered highly productive; and it may be safely affirmed, that there is hardly a spot of waste land in the kingdom so barren, which by the exercise of skill in planting, and selection of proper species of forest-trees adapted to the soil and exposure, might not be covered with profitable plantations.

Numerous instances might be cited from different parts of the kingdom where exposed and sterile lands have, by planting, been made capable of producing valuable arable crops and the best pasture grasses, and of rearing and fattening stock of improved breeds. This, in effect, is adding to the territorial extent of a country, to its wealth and strength, by conquest over the natural defects of local climate, soil, and exposure.

Chapter II.

Of the Structure of Trees, and of the Natural Agents which influence and govern the growth of the Plants, from the period of Germination until the Trees arrive at full maturity.

Plants being living organized bodies, a just knowledge of the functions of their vital organs, and of the principal natural agents which influence their progress of growth to maturity, will be found a useful, if not an indispensable assistant to guide the practical planter in rearing trees in the most

judicious and successful manner. This part of the subject properly belongs to vegetable physiology; and as the limits of an essay do not allow of entering into minute details, we shall here only notice those leading features of the structure of trees, and those functions of their vital organs, which more immediately influence the practical operations of the planter. In considering the progress of vegetable life, physiologists have distinguished six principal parts of a tree: the *root*, the *stem*, the *branches*, the *leaves*, the *flowers*, and the *fruit* or *seed*.

The varieties of the root of forest-trees are characterised by the names of tap root, fibrous root, and creeping root, these may be considered rather as indicating particular states of the same organ at different stages of growth than as permanent or specific distinctions *.

The tap root is that which first appears on the vegetation of a healthy seed, and penetrates perpendicularly into the soil. From it issue numerous minute radicles; and as the proper leaves are developed, lateral roots or fibres are formed and sent out from the sides of the tap root, particularly at the point of junction situated between the radicle and stem.

As the plant advances in age the distinction of the tap root is lost, either by decay or by its taking a horizontal direction in common with the general mass of roots, and from which in a few years it is not to be distinguished. Other leading roots are frequently formed from the first delicate lateral fibres, which pervade the tap root, and sometimes from its extremity when it happens to divide into parts, which always takes place when the extremity comes in contact with a richer or more genial soil, or, on the contrary extreme when it meets with obstructions in its first or early descent from whatever cause, rocks, gravel, &c., or by injury from insects: if the tap root be taken from the seed leaves before the plumula appears, or before the development of the proper leaves, the young seedling dies; and, again, should the tap root be deprived of the seed leaves before the production and expansion of the proper leaves, no farther reproduction or growth takes place. The uses of the tap root, it will readily be perceived from these facts, are of great importance to the plant in its first stages of growth, and may be compared to the equally essential and important uses of the seminal leaves, at the same period; but its subsequent destruction does not, as it has been supposed, influence injuriously the ultimate produce or value of the tree.

Two or any equal number of trees, for instance, of the same age, of the like constitution, and reared on a soil of the same nature, the one from seed on the spot, the other being transplanted from a nursery bed, without, or with a portion only of its tap-root, will give results which prove that trees, when transplanted at a certain age and size, and in all other respects of culture under the same circumstances, produce timber in quantity and in quality equal, if not superior to untransplanted seedlings. Whether, therefore, to raise forest-trees from seed on the spot where they are to

* In practical planting, as well as in practical botany, the root is considered to be that part of a plant which is hid underground, and the varieties of it are characterized according to the shape and mode of growth, as bulbous, tuberous, fibrous, or creeping; these again are susceptible of subdivision as they vary from the type. In physiology, however, the fibres or radicles are alone recognised as the roots, as it is they only which take up the food of the plant supplied by the soil.

The tuber of the turnip, potato, &c. and the bulb of the hyacinth, &c. are properly reservoirs in which to deposit the food of the plant until wanted in season for the production of leaves, flowers, and fruit, or seed. Indeed, bulbs and tubers may be considered the plant itself in certain stages of its progress to maturity. A deciduous forest-tree in winter, when without its leaves, flowers, and seed, may be compared to a bulb or tuber, when destitute at the same time of these parts of a plant. Roots, in general, are also distinguished in practice as to duration, being annual, biennial, and perennial.

produce timber, or in nursery beds, and afterwards transplant them, is a question of mere expediency.

Where seeds of the kinds of forest-trees desired can be had at little cost; where the soil is friable, is in a perfectly clean state, and consequently adapted to the plough culture; where such animals as are destructive of seeds and young plants, as mice, rooks, and game, particularly hares and rabbits, are not likely to be greatly destructive; and where the cost of labour is not comparatively high, then sowing the seeds of forest trees on their timber sites, may be the best practice and be adopted with success. But where, on the contrary, these obstructions exist or are probable, transplanting select healthy trees from nursery beds, though the plants be deprived of their tap roots, will be found more economical in the first outlay, and in the subsequent cost of culture; and the most profitable, as affording a quicker return of profit in prunings and thinnings, and will produce timber in a less number of years from the time of occupying the land for that purpose.

The fibrous root is that which is most common to forest-trees. It consists of numerous divisions or bundles of fibres, furnished with minute spongeols, and nearly representing the divisions or ramifications of the large and smaller branches and buds of the tree.

The variety of creeping root is chiefly confined to those trees which have the roots running horizontally, as in some species of poplar, elm, &c.

The organization of the root is similar to that of the stem and branches, from the *pith* which forms the centre of the body to the *epidermis* which covers the bark. Each part may be traced in uninterrupted continuation, from the minutest radicle of the root to the extremity of the smallest branch or bud of a tree.

When a root of whatever kind is divided, its horizontal section exhibits three distinct parts, the *pith*, the *wood*, and the *bark;* and a transverse section of the *trunk* of the tree, or of a branch, exhibits exactly the same parts.

The *pith* forms the central circle of a *root*, *stem*, or branch: it is a cellular membraneous body of a silvery white colour. As the tree or root advances in age and the timber is perfected, the pith gradually loses its original spongy texture, the cells of which it is composed becoming more and more compressed until all appearance of it is lost in the wood, excepting that the concentric circle which it occupied appears whiter than the other annual layers. But although the pith thus disappears in the old, it still continues in progress with the young wood of the root, stem, or branches; and the periodical fibres or radicles of the former, and the buds or embryo branches of the latter, will on examination be found to originate from it. When a branch is pruned off close to a stem wherein, from age, the pith has disappeared for some distance above and altogether from below the origin of the amputated branch, no reproduction of shoots takes place in whatever season the pruning may be performed, but should a portion of the branch be left to the stem, from that buds and shoots will spring. It also happens that when a branch is pruned off close to a young healthy stem containing perfect and active pith, before or shortly after the completion of the midsummer growth, which usually takes place before the end of July, no reproduction of shoots follows the operation, but the efforts of the vital functions of the plant appear to be wholly directed to cover the wound with fresh bark. Should the pruning, however, be performed in spring before or shortly after the expansion of the leaves, or after their fall in autumn, a reproduction of buds and shoots ensues, and a slower progress in the formation of new bark is apparent.

The presence of leaves is essential to the growth of buds and branches, and consequently to that of the pith in these and in the roots; but the leaves are not otherwise necessary to the formation and growth of the fibres or radicles of the root, as these are produced in abundance when the plant or tree is leafless, and even during winter when the ground is covered with frost and snow, the reservoir of nourishment in the *pith* being probably sufficient for that purpose.

From these facts and others which might be brought forward, it is clear that the uses of the pith in the formation of buds in the branches of the tree, and of fibres or radicles in the root, and in the support of these during the first stages of growth, are analogous to the important functions of the seed leaves in the first stages of growth of the seedling plant. The pith of a radicle or fibre may readily be traced into that of the root, and the same is precisely the case in a branch with relation to the stem of the tree. The respective uses of these organs are only for the first and early stages of growth; and, after that, they may be lost without any apparent injury to the further progress of the parts in question: the cotyledons dry up and fall away as the healthy progress of the roots and leaves advances, and the pith disappears, or its identity is lost in the wood, as that part of the structure which surrounds it approximates to maturity. *

The *wood* stands next in order to the pith, it is formed of indurated vegetable fibre, and occupies the space between the pith and the bark; it constitutes the bulk and strength of the subject. The yearly growth or increase of the wood is defined by circular lines or concentric layers clear to common observation in a transverse section of any root, branch, or stem. The discriminating characters of the wood being more obvious in the stem, than in the root or rootlets, we shall consider it more particularly when mentioning the stem.

The *bark* covers the wood in every part of the tree, and is the most important organ of vegetable life, for the pith may be lessened, the wood may be partially or even wholly taken away, and, the leaves may be stripped off, and yet the tree may recover, but when deprived of its bark, the root, stem, or branch of a tree dies. It is therefore of the greatest importance to the practical planter, that the bark of the roots and of the exposed system of his plants should be preserved free from the slightest injury.

The bark when divided horizontally shews three distinct parts, the liber, or inner bark, which lies next to the wood; the cellular tissue, or parenchyma, which is distinguished in the bark of the exposed system of the plant by its fine green colour, but which is colourless in the bark of the root; and, lastly, the epidermis, or outer bark, which is the universal covering of every part of a tree.

* A scion grafted on a stock, and a bud separated from its parent shoot and inserted into the *bark* of another tree, may at first sight offer proofs going to invalidate the opinion of the important uses of the pith in the formation of buds and fibres; but before the scion and the bud are taken off, or are in a fit state for the purposes of budding and grafting, the pith of the parent stock has already performed its offices. The important experiments of Mr. Knight on this subject prove that the pith may be removed in part without effecting the general health of the tree, just as the cotyledons may be removed from the young plant after having established its root and stem, with a continuation of pith to originate new buds, or embryo branches and radicles. We often meet with roots, which from severe injuries by mutilation at an advanced age of the tree, or by the injurious effects of a damp ungenial soil at an earlier period of growth, have lost the entire substance of the pith and wood, and present the appearance of a hollow tube, have yet young fibres or radicles issuing from their sides and continued as in roots where the pith and wood is perfect; on examination, however, these young fibres may be traced through the bark into the hollow of the root, demonstrating the origin of the radicle from the pith.

On young shoots and stems the epidermis appears membraneous, or as a thin transparent membrane without vessels; but late researches, aided by powerful glasses, have shewn that it is partially furnished with minute retiform vessels, particularly in the leaves.

When casually displaced off young shoots it is reproduced with little apparent injury to the part, unless it happen on the annual parts of the tree, as the leaves and flowers. In old stems and branches the epidermis often attains to considerable thickness, becoming hard, rough, or granulated, as seen in the trunk of elm, oak, and most kinds of forest-trees, and in the trunk of the apricot, pear, &c., among fruit-trees. When in this latter state, the epidermis may be removed without injury, and, in some instances, it has been cleared away from these fruit trees with evident advantage to their general health and fertility *.

The parenchyma is composed of hexagonal cells, containing juice, which in the stems and branches is of a green colour, even when covered by a thick indurated epidermis; but in the root, as before alluded to, the juice of the parenchyma is colourless.

The inner bark consists of cortical layers, constituted of longitudinal fibres or vessels, which are supposed to return the sap from the leaves after their undergoing certain changes by the action of solar light, heat, and air. The medullary rays which pass from the pith to the cellular textures of the inner bark and parenchyma in a horizontal direction, appear to be the medium of a lateral intercommunication of sap and air throughout the entire structure of the tree†.

The green colour of the parenchyma depends on the exposure of its epidermis to light and air; for when a portion of the stem of a tree is excluded from light, as is sometimes done in planting when the tree is placed deeper in the soil than it stood before transplanting, the green colour is destroyed in that part of it which is covered with the soil, and which in course of time assumes the colour of the root; and, if much moisture exists in the soil and the tree be not young, the bark so covered decays, and the tree dies. Should the soil be dry, however, and the plant

* In 1813 the following trial was made to ascertain the effects of removing the rough, hardened epidermis from the trunk and limbs of a very large and aged Crassane pear-tree. The tree was trained horizontally on a west wall, the branches extended twenty feet on each side of the large trunk in the most perfect order. The stem was cleared of the *rough* epidermis entirely, and the branches on one side also were treated in like manner. The branches which extended on the other side of the stem, had only every alternate branch stripped of the rough, hardened epidermis. Previously to this, the tree had for many years ceased to bear fruit, except occasionally one or two at the extremities of the upper branches. The first season after the above operation, the foliage assumed a more healthy appearance on the decorticated branches, and in the course of the second year many fruit buds were formed, which afterwards produced fruit of very good quality. The branches which were suffered to remain with their hardened epidermis, continued barren. Adjoining to this tree was another of the same species, apparently of the like age and of nearly the same dimensions. In this instance every second branch was pruned off near to the stem, and young grafts of the crassane, colmar, brown beurrie, and St. Germain, united to stumps of those branches respectively. These grafts all succeeded so well that in four years from the period of grafting they had nearly attained to the length of the old branches, and produced full crops of fruit of a very superior quality. The old branches, which had purposely been left, remained in the same barren state as before. The branches produced from the grafts were superior at the end of the fifth year, in regard to health and produce, to the decorticated branches; and these last were in a like proportion superior to those branches which were left untouched. These facts go to prove clearly that the thickening and hardening of the epidermis has a very considerable influence on the health and fertility of a tree.

† It is contrary to every known law of the vital power, to suppose that any part of the structure of a living organized body can resist decomposition or decay, if it be cut off from a reciprocal communication with the circulating vital juices.

young, the bark in question is gradually converted into root-bark; during this conversion of the stem-bark to that of the root, the plant advances but little, if any, in growth, but exhibits an unhealthy appearance by the paleness of its leaves, and the weak growth of shoots. The same effects are in a great degree observable from the opposite error, of planting too shallow, which is when a portion of the root nearest to the stem is left above the ground. This exposed portion of the root-bark in time gains the green colour in its parenchyma; and although no portion of it is ever found to decay, as in the former instance, yet, for a time, the plant makes but little progress in the growth of wood: if a fruit tree, the effect appears to be to increase the formation of fruit buds, and to stimulate the functions of the tree to bear fruit. It may not be devoid of interest to remark here, that this is a more efficacious mode of inducing a free growing though barren fruit-tree to bear fruit, than any of those recommended for that purpose, such as *ringing*, or placing an iron ring round a branch to prevent the annual increase of bark on the space occupied by the ring, cutting the bark in the manner of a circular incision of a branch, dividing the roots, and by reversing the natural direction of the branches. It may be unnecessary to add, that the above facts point out the importance of planting every tree not deeper in the ground, nor farther out of the surface, than the root occupied in the soil previous to transplantation; most essentially when the produce of wood or of timber is the primary object desired.

The *stem*, *trunk*, or *bole*, constitutes the principal body of a forest-tree. It is the medium of communication between the root and the branches, leaves, flowers, and fruit or seed. By the exercise of this function it obtains its yearly increase of substance, marked by the white circular lines apparent on the surface of a transverse section of the stem of every species of forest-tree. By counting the number of these circles the age of the tree may with certainty be determined.

It was before observed that the structure of the root was similar to that of the organization of the stem and branches; but a more particular notice of the constitution of the wood was referred to this place.

A close examination * of a horizontal section of the wood of a trunk or branch of a tree, will exhibit two very distinct appearances.

1st. A series of white and shining laminæ, which radiate from the pith to the bark (*fig. b*, 1)†. These generally straight, or sometimes interrupted, lines are termed the silver grain or medullary rays of the wood. These vary as to size and arrangement, termed primary or secondary rays, continued in one straight line from the pith to the bark, or interrupted and broken in the course of their direction, according to the species of tree which affords the wood in question. They appear to be composed of cellular tissue, and to originate from the pith, or, in a word, are a linear lateral extension of that organ. These medullary rays are elastic and contractile, as is evident to every one who has observed the effects of the extremes of dry and of moist weather on the section of a felled tree.

2d. A series of concentric layers, or circles, termed the spurious grain. These consist of tubular vessels of smaller or larger diameters, arranged in lines or groups varying according to the genus and species of the tree to which the wood belongs.

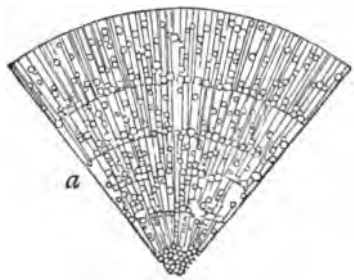
* With a common or four-power microscope. A thin slice of the substance is, perhaps, the most convenient for examining. When placed under a high magnifying power the beauty, order, and arrangement of the tubular and cellular texture will reward the observer.

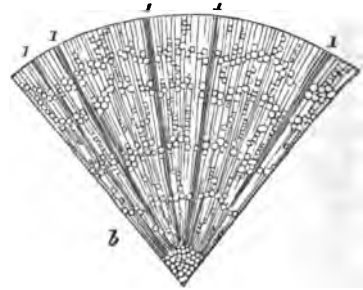
† These should be examined with a magnifying glass, for the texture of the different woods exhibited will thereby be more satisfactorily compared with the descriptions which accompany them.

An examination of many different kinds of wood proves that these characters of distinction are constant, and, therefore, afford a certain means of distinguishing the wood or timber of one species of tree from that of another.

The following discriminating characters of the woods of the principal timber trees will be found constant:—

The wood of the elm (*fig. a*) is distinguished by having the medullary rays, or silver grain, equal, and not crowded. The concentric layers are composed of a series of cells of nearly unequal diameter, arranged in an almost simple curved line. The spaces between the layers are furnished with cells of a smaller diameter, and rather thinly scattered over the surface.

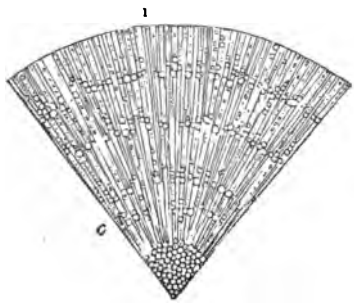


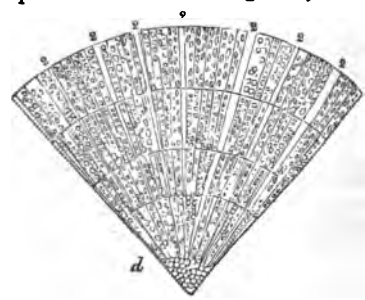


The oak (*fig. b*) has two series of medullary rays; the primary ones are large and strongly marked, distant from each other, and are uninterrupted in their course from the pith to the bark (*fig. b*, 1). The secondary rays are numerous between the primary, but not crowded.

The concentric layers, or circles, are distinguished by the arrangement of the cells. They are grouped in somewhat triangular masses, forming a wavy circular outline. The structure of the concentric layers or annual rings, distinguish at once with certainty the wood of the oak from that of the chestnut, with which it has often been confounded.

The wood of the ash (*c*) has the places of those rays so prominent on the wood of the oak, supplied by twin rays (1) placed in wide intervals over the surface, and between these double rays are smaller ones, placed in regular order. In the narrow spaces between the individuals which constitute the twin rays are wanting those apparent remains of the cellular texture which are so remarkable in the spaces between the single rays.

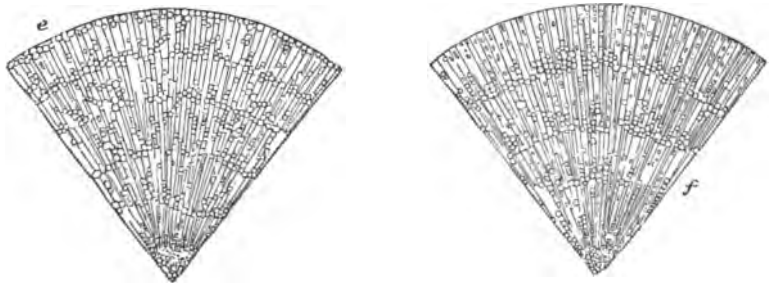




The wood of the beech (*d*) has the primary rays (2) dispersed pretty regularly over the surface of a horizontal section of the wood; the secondary rays are not continuous from the pith to the bark, but interrupted,

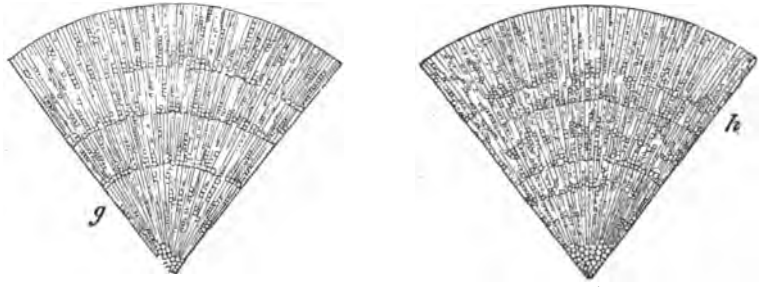
and exhibit a numerous series of fragments of rays, filling up the spaces between the primary ones, obvious to the naked eye, and rendering the silver grain, as it is called, of the beech very distinct from any other kind of wood.

The wood of the Spanish or sweet chestnut (*e*) has often been confounded with that of the oak; but its characters of distinction are very obvious. It agrees with the oak in having the secondary rays equally disposed, almost straight, and, though close to each other, yet not crowded as in the elm and beech; it differs, in the primary rays being scarcely to be distinguished from the secondary, whilst in the oak these are prominent and obvious to the naked eye on the slightest inspection. The concentric layers are regularly curved, whilst in the oak they are strikingly waved. The mouths of the tubular vessels, which constitute so obvious a part of these annual rings, or layers, are disposed in triangular masses in the oak; on the contrary, in the chestnut they are in regular order.



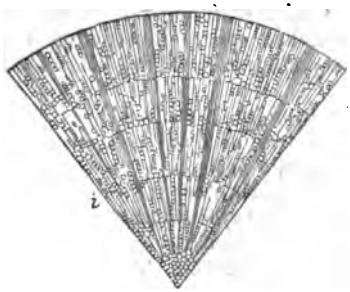
The hornbeam (*f*) has the rays of the wood nearly equal, but may readily be distinguished from that of the beech, to which it bears the greatest resemblance, by the simple arrangement of the tubular structure accompanying the concentric layers, which in the hornbeam are distant and oval shaped, the narrow sides pointing to the pith and to the bark; in the beech they are circular shaped, more numerous, and equal sized.

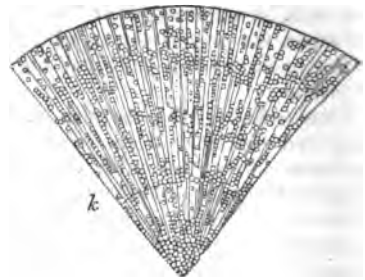
The birch (*g*) has all the medullary rays nearly equal, arranged closely, and having the concentric circles minute, but marked with a row of equal cells.



The horse chestnut (*h*) has all the rays very minute, few of them apparently continuous, but interrupted, and in substance varying in breadth. The cells are numerous and minute.

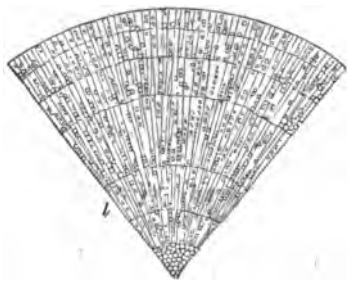
Alder (*i*) has the wood with large primary rays, thinly arranged, but in nearly regular order; the secondary rays are slender, numerous, and interrupted. The cells of the concentric layers are nearly regular. The spaces between the rays are crowded with cells.

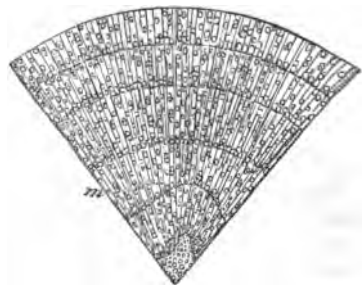




Oriental plane (*k*) has the primary rays regular but closely arranged; they are somewhat wavy; the cellular texture of the concentric layers but slightly marked.

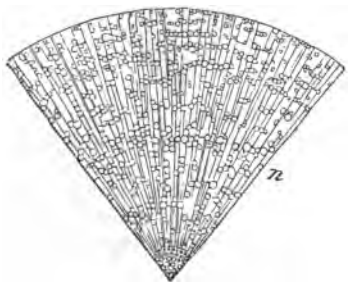
The sycamore (*l*) in texture approximates to the plane: still, however, it is very distinct in its straight lined rays, which are very minute or slender. The cellular texture is composed of such minute cells as scarcely to be perceptible under a four power microscope; these cells are, however, very numerous.

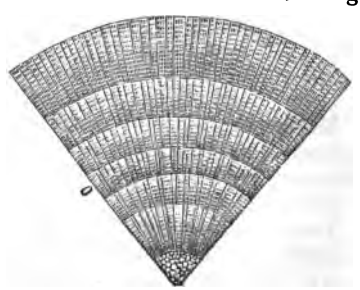




The poplar (*m*) has the wood composed of rays so slender as not to be obvious to the naked eye. The concentric layers are composed of exceedingly minute cells. This wood is extremely porous; the cells of which it is composed are so numerous that a very thin slice of the wood, taken horizontally, exhibits the appearance of the finest possible open net-work.

Common acacia, or locust, (*n*) has wood which bears some resemblance to that of the oak; but it is very distinct from any other kind mentioned here; it wants the distinct primary rays so prominent in the oak, the rays of the locust being all nearly of equal breadth, and as slender as the secondary rays of the oak; here they are somewhat wavy. The cellular or tubular structure is also very different from that of the oak, being

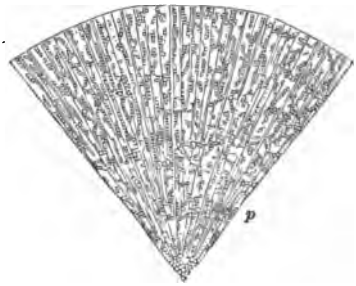


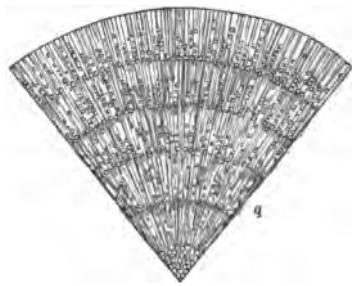


arranged in more regular order where they mark the concentric layers, and the spaces between the rays are furnished with many cells irregularly scattered over, of a size equal to those marking the concentric layers.

The wood of the fir (*o*) is distinguished from all others here enumerated by having very prominent coloured concentric layers, arranged very regularly throughout; and the cellular texture, though composed of cells sufficiently large to be seen with the naked eye, is not to be distinguished without very close observation.

The lime (*p*) has very slender equal rays and a minute cellular texture pervading the whole body of the wood. The concentric layers are scarcely perceptible to the naked eye. It may be compared to the wood of the poplar, but the network-like arrangement of the cellular texture is not so obvious in the former; the presence of the rays in the lime distinguishes it at once from the poplar.





The wood of the laburnum (*q*) is distinguished by its minute, regular, uninterrupted medullary rays, and by the broken beaded longitudinal lines of the tubular structure.

These characters of distinction being permanent and constant in all these different kinds of wood, will be found useful in cases where it is desirable to ascertain the kind of timber which may have continued sound for the longest period in any particular building or situation, and the contrary where its duration has been limited *.

The *leaves* constitute one of the most important conservative organs of vegetable growth; for on the free and healthy exercise of their functions depend the life of the plant and its progress to maturity, to say nothing of that universal interest and pleasure which is afforded by the diversified beauty of their forms and tints. The green colour of the leaves of trees has been proved, beyond all doubt, to depend chiefly on the influence of solar light and atmospheric air. Almost every distinct species and variety of plant, in its most healthy state, has its own peculiar shade of green: the yellow-green tint of the foliage of a healthy larch, would in that of a pine, spruce, fir, and cedar of Lebanon, be certain indications of disease and decay. The dissection of a leaf shews that it is composed of vessels, cellular tissue, and an epidermis. The green part of a leaf is, in fact, a continuation of the parenchyma of the bark before mentioned; and the mid-rib and nerves of the leaf are a continuation of the conducting and returning sap, and air vessels of the bark and alburnum. The under and upper surfaces of the leaf may be separated in an entire state from each other. These appear to perform different offices; the under surface is provided

* It would be of the greatest utility to the interests of planting were registers kept of the kinds of timber used in particular buildings; also the age of the tree which produced it, when felled, and the soil, and situation or climate, in which the trees were reared. Posterity would be grateful for such records of facts.

with numerous minute pores by which moisture and air are emitted and absorbed. The upper surface of the leaves of trees is supposed to be destitute of pores: this part always turns its surface to solar light*.

The leaves of forest-trees are either simple or compound; simple as in the common beech, and compound as in the ash, where several smaller leaves are attached to one foot-stalk. The foot-stalk of the leaf is terminated by a gland, which in deciduous trees, or those that shed their leaves in autumn, becomes indurated, and at that season readily separates from the branch or twig.

The midrib of the leaf is merely a continuation of the footstalk; this divides the body of the leaf longitudinally; it may be compared to the stem of the tree, for from it issue branches of various sizes, dispersed through the substance of the leaf in order resembling those of the tree. The first or largest series of fibres issue from the sides of the midrib, either in an opposite direction, alternately, or irregularly, according to the species of tree; from these secondary branches proceed a third and a fourth series, not however in such straight lines as in the former, but curving and anastomising, or opening into each other in all directions, and, in this last particular, they have a resemblance to the disposition of the minute blood-vessels of the animal economy. The difference in the disposition of the first and secondary fibres of the leaves is so constant in the individual plants of different natural genera, that it affords a very clear discriminating character by which they may be distinguished from each other, in the same manner as the wood of different kinds are identified by the concentric circles and medullary rays before mentioned.

The leaves of the oak (Quercus) have the secondary fibres few in number, and curved towards the sinuosities of the leaf; the third series of fibres are very prominently marked, and the fourth series extremely minute. The leaves of the Spanish chestnut (Castanea), belonging to the same natural order but to a different genus, have the secondary fibres nearly straight, the third series very numerous and curved alternately, the fourth series nearly as large as the third, and if we examine and compare the wood of the oak and the chestnut, we shall find equally marked distinctions between them.

In the beech (Fagus), which likewise belongs to the same natural order, but to a different genus to the above, the secondary fibres of the leaves are very prominent, and the third and fourth series minute, and of nearly an equal size, and the texture of the wood is equally distinct from that of the oak and the chestnut.

That the leaves of plants during the day emit oxygen gas or vital air, and absorb carbonic acid gas or impure air, has long since been proved. In the night or during darkness, vital air is absorbed by plants and unhealthy air emitted, and it would appear by various experiments on this important point, that when the supply of carbonic acid gas from the air and soil is greater, the emission of oxygen gas by the leaves during their exposure to sunshine is also greater, hence another cause of healthy plantations improving the climate of their neighbourhood besides that of shelter.

The leaves of trees being the great organs for elaborating the sap and fitting it to become converted into all and every product of the tree, whether timber, bark, seeds or fruit, render the facts relating to their structure and functions of high interest to the planter and forester; for they point out the danger of lessening their number beyond a certain extent, as in excessive

* For a minute and interesting account of the varied forms of these pores, and of their number on different plants, see Part I. 'of Vegetable Physiology,' published in the Library of Useful Knowledge.

pruning, or of suffering the leaves to be crowded too much, so as to exclude a free admission of light and air, as happens when trees are planted too close together, and judicious thinning and pruning are neglected.

The seeds of forest trees. Seed consists of three principal parts: 1st. The *cotyledons*, or seed leaves;—2dly. The *rostel*, or first radicle, which descends into the soil, and becomes the root of the tree;—3dly. The *plumula*, which ascends, and becomes the stem, bole, or trunk. The rostel and plumula are closely united in the seed, and there constitute what is termed the germ, or embryo of the future tree. This is an essential part of the seed, for however healthy in appearance the seed may appear, if the germ be injured, the seed never vegetates. The cotyledons or seed-leaves contain a farinaceous substance which is the source of nourishment to the radicle, until established in the soil and fitted to perform its proper office in the development of the stem and proper leaves of the plant. It may be useful in this place to mention, that the seeds of forest trees may be classed under the following heads or general characters, indicating peculiar points to be observed in the practice of sowing them.

1st. *Seeds farinaceous, and covered with shells, nut-seeds.* To this class belong the oak, Spanish-chestnut, beech, horse-chestnut, walnut, hazel, hornbeam, plane, sycamore, maple, and ash, to which may be added, though not strictly belonging to the group, the birch, alder, and lime. The first seven kinds, from the farina they contain, are least adapted for keeping out of the soil, and the same cause renders them more difficult to preserve in the soil when sown, by inducing the attacks of mice, birds, and other vermin. The spring is considered the best season for sowing, and the seeds must therefore be preserved carefully during winter; the most approved mode is to spread them out in their layers on a cool dry floor, but previously to this they should be thoroughly dried by the sun and air. The smaller kinds of seeds after being sufficiently dried, may be kept in a smaller space. The seed of the oriental plane (*Platanus orientalis*), however, succeed best when sown immediately as it is perfected. When sown, these seeds require different degrees of covering in the soil. The larger seeds, as those of the chestnut, oak, &c., should be covered with two inches of mould; for the smaller seeds of the plane, sycamore, hornbeam, maple, and ash, it will be proper to mix with them sand, in quantity about equal to their bulk, placing the mixture on the ground a foot in thickness, and covering that with an inch thick of mould. The birch may be sown immediately as it is taken from the tree, or preserved in the seed-loft until spring. When sown, the birch is generally covered half an inch with mould, the former seeds with one inch.

2nd. *Hard seeds, or stones covered* with a pulpy fruit. The proper covering of these seeds is so hard, as to have acquired for them the name of stones. In this class are the cherry-tree, mountain-ash, whitebeam, yew, holly, pear, crab, and thorn. With the exception of the cherry-tree, all these remain in the soil one or two years before they vegetate. To obviate the irregular vegetation of these seeds, which is attended with loss of time and inconvenience, the practice of preparing them for sowing by what is called pitting has been adopted; this is done in the manner above mentioned for the hornbeam, plane, &c.; but as one, two, or even three years in the pit or preparatory bed are wanted for some of these seeds, it is requisite after they have lain a certain time in the pit to uncover them and turn them over, so as to assist in the separation of the pulp from the stones. Holly berries require one year at least to prepare them for sowing; mountain ash, whitebeam, yew, and ash lie one year; the cherry readily vegetates in the same spring in which it is sown.

3rd. *Leguminous, or bean seeds.* These, as regards forest-trees are confined to the common acacia, or locust-tree (*Robinia Pseud-Acacia*), the glutinous Robinia (*Robinia viscosa*), and the laburnum. These seeds vegetate freely when sown from the tree, but it is the general practice to preserve them until spring in a dry, cool place. When sown, they require to be covered with about three-fourths of an inch of mould. If sown too thickly, that is, less than one inch seed from seed, the plants soon injure one another and become diseased.

4th. *Light seeds.* Under this head we enumerate smooth elm, and mountain elm, the poplar, and the tree willows. These seeds being light, and separating freely from the tree when ripe, require care in collecting, as otherwise they are liable to be dispersed and carried away by the wind. They vegetate quickly and may be sown so soon as they are ripe. Spring however is preferred, as tender seedling plants are subject to injury from severe weather in winter. They should be covered to the depth of one fourth of an inch of fine sifted mould.

5th. *Resinous seeds* are those of coniferous or fir-trees. Their vegetative power when cleaned or separated from the cones, is not to be preserved if they are kept out of the ground for any considerable length of time, and they require particular care in sowing. The soil of the beds ought to be of a light sandy nature, enriched with the vegetable mould of decayed tree leaves, or well decomposed dung. If a proper quantity of the former manure be added, and well incorporated with the sandy loam above described, it will bring that soil to a suitable texture. The seeds are borne in cones furnished with scales of a hard woody consistence. The cones of the larch with much difficulty part from the seeds, and various means have been adopted to effect that object. The best is that of first opening the cone, or dividing it lengthways into two or four parts, then placing them on a kiln and drying by a very gentle heat until the valves begin to open, when they should be taken to a proper floor and threshed: the seeds may then be separated by a sieve. The cones of the Scotch fir and the spruce require also the aid of the kiln; but the seeds part from the cones easily, and the splitting of the cones is superfluous. The spring* is the best season for sowing these seeds. The soil of the seedling beds should be in as finely a pulverised state as possible for their reception.

The seed of the stone pine requires to be covered with one and a quarter inches of soil, the silver fir and pinaster with one inch, the Weymouth pine with three-fourths of an inch; the Scotch fir, Norway spruce, balm of Gilead, and cedar of Lebanon with half an inch of soil. The cedar of Lebanon is best sown in boxes placed in a warm or sheltered situation. The larch should not be sown so deep; a covering of a quarter of an inch of soil suffices. The white, red, and American spruce firs, having smaller seeds, require a slighter covering of a fifth of an inch deep, and the texture of the soil should be even lighter, which can be easily effected by adding sand or a larger proportion of the mould of decayed tree leaves. Heath soil, or bog soil, containing a good proportion of fine siliceous sand, has been found very congenial to the vegetation of these seeds.† Shading

* If the winter happened to be favourable, and the depredations of vermin were completely prevented, the balance would be in favour of sowing the seeds of the fir and pine in autumn, and which would be the case also with every description of forest-tree seeds, the hard or stone seeds probably excepted.

† This description of soil has been erroneously supposed to be injurious to transplanted firs, and implements are used to remove the heath soil from the intended sites of the plants, in order that the roots may be inserted in the subsoil of gravel or sand, of which the subsoil almost always consists. The roots of the heath while alive are the cause of injury, not the nature of the soil.

from hot sunshine is highly beneficial to them, indeed, indispensable in some states of the weather, for the thin covering of soil which is necessarily allowed them is soon affected by the action of the sun's rays, and sudden drought quickly destroys the tender seedlings. The thickness in which the seeds should be sown, according to the respective kinds, is on an average from three to four on a square inch, so that the plants when produced stand not nearer to each other than that scale of distances.

The artificial fine state of culture of the soil in the seed beds, rendering it less retentive of the due degree of moisture than is required, the beds should be consolidated before and after the seeds are sown, either by the use of a roller, or by the spade.

In concluding this practical view of the structure of forest trees, and of those natural agents, which obviously influence the growth of plants, it may be useful to take a similar view of the process of vegetation. A perfect and healthy seed consists of an outer covering, cotyledons, radicle, and plumula. When sown in perfectly dry earth, it remains unchanged; if in an excess of moisture, it loses its vegetative powers and decays: in neither case it vegetates. When the temperature of the soil is below a certain point, all vegetation is suspended. Should the soil and the temperature be perfectly favourable to vegetation, yet if the seed be not planted shallow enough to be within the influence of atmospherical air, no vegetation takes place. Different species of seeds require different degrees of moisture, temperature, and atmospheric influence, to render their vegetation the most healthy and perfect. The natural constitution of different soils, as regards their respective properties of retaining or easily parting with moisture; the proper season of sowing, as regards the temperature of the soil and the atmosphere, by whatever local causes subject to be influenced; and the respective depths to which the seeds should be deposited in the ground, as above mentioned, apply directly to the skill of the cultivator to aid, modify, and assist these primary essential agents of vegetation; and on the right adjustment of these depend the success and just reward of the planter in this first stage of the process of his art.

In whatever position the seed is placed, the radicle first bursts the covering, and takes a downward direction into the soil, where it becomes fixed, and protrudes, at right angles from its sides, numerous rootlets, which in their turn emit others; then, and not till then, the cotyledons rise above the surface and expand, shewing the plumula or bud of the stem, which now advances in growth and unfolds the proper leaves. After the leaves are fully expanded, the communication of the pith with the buds, formed or forming, at the base of each leaf-stalk in the angle made by that and the stem, may be traced. The loss of either of these organs of the seed at an earlier period would have prevented farther growth; for if the cotyledons had been seriously injured or taken away, the radicle and plumula would have died; if the radicle had been removed, the same effect would have followed; or if the plumula had been taken away, the plant would have made no farther progress. But as soon as the formation of the germ of buds is effected, as now stated, the cotyledons may be removed; the summit of the stem and the lower extremity of the radicle may be taken away, and the plant will reproduce others. It is during the previous stage of growth that the attacks of insects prove so fatal to seedling plants, and require the utmost care of the planter; and hence also the greater care and attention that is demanded in the preparation of the soil for seeds than for the reception of transplanted trees. This also points out the danger of injury to the vegetating seeds, by disturbing the seed beds before the

plants are perfected. It is in these early stages of growth, that the foundation is laid for the future health, beauty, and vigorous growth of the tree. The fibres of the root, with the minute spongeols before mentioned, now imbibe and send up the food of the plant to the leaves, where being spread out to the influence of solar light, heat, and atmospheric air, it is elaborated and returned through the foot-stalk by the longitudinal vessels of the inner bark to the root, depositing in its course, or in conjunction with the original fluids of the cellular texture forming, the various substances and secretions peculiar to the tree. That the sap ascends by the longitudinal vessels of the alburnum, sap, or soft wood, and descends by those of the inner bark, seems to be proved by the experiments of Mr. Knight and others, who have more intimately investigated this part of the subject. That a lateral movement of the sap goes on at the same time, and in conjunction with the ascending and descending movement, appears equally certain*. Every individual leaf of a tree is furnished with its own particular series of vessels for the course of the sap, and not only prepares and elaborates the sap for the increase of substance of its own branch, but also for that of the parent stem and root. Hence it is that trees regularly furnished with branches from the base upwards have more tapering stems, than trees with branches confined to the upper half of the stem, the increase being equal, from the point where the branches begin, downwards to the root; or, in other words, whatever length of stem from the root upwards is destitute of branches, that part of it from the period of losing them increases in size equally throughout†. Without a just knowledge of this principle in the economy of vegetable life, the important process of pruning in the culture of forest-trees cannot safely be performed by the forester: that the sap never ceases wholly to move ‡ is evident in the increase of the roots and buds during winter when the plant is leafless; but its ascent is particularly distinguished for greater force and activity at two periods of the year, spring and midsummer. The ascent in spring is the strongest, and continues until midsummer, gradually diminishing in force as the new branches and leaves are perfected. This generally takes place about the beginning of July, when an apparent cessation of ascending motion in the sap immediately succeeds, and continues usually for the

* The sap in ascending is farthest removed from the action of solar light, heat, and atmospheric air. in descending it is nearest to these important agents, receiving their impulse through the medium of the green cellular tissue or parenchyma. The offices of this organ in transpiration and inhalation, may be compared to that of an universal leaf covering every part of the stem and branches of a tree.

† This fact may be demonstrated most conveniently, by pruning the lateral branches off quite close to the stem of a young fast-growing tree, leaving a certain number to form a top, and to keep up the growth of the plant.

‡ The term *circulation* has been objected to as improper for describing the course of the movement of the sap in plants; because a point from whence the movement begins, and to which it again returns (as for instance, the heart in animals,) has not been discovered in plants; for in these the sap is periodically exhausted in the increase of the substance of the tree, and its place periodically supplied from the soil to the spongeols of the roots. The term periodical is here understood to apply to the effects observed, by the practical planter, of the spring growth, midsummer growth, and leafless or winter cessation of growth, annually in the progress of every forest-tree. That the roots of these plants (as long as their vital powers continue to act) continue, *without intermission*, to imbibe fluid or pabulum from the soil, however small in quantity that may be at certain seasons, seems highly probable; as also that a movement or circulation of the fluids of the cellular texture, however languid it may be, exists even in the leafless tree. But there are plants, such as the hyacinth, potatoe, onion, &c. &c., which remain two or three months annually during their progress of existence, without a possibility of imbibing anything whatever by their roots, rootlets, or spongeols, inasmuch as during that period of their existence they are destitute of these organs wherewith to imbibe.

space of a fortnight or three weeks, according to the age of the plant and the state of the weather. A second ascent of the sap, and growth of shoots now take place, but with diminished vigour; unless from accident, disease, or unfavourable weather, the spring growth has been checked, and the first flow of sap prevented from being exhausted in the production of branches, leaves, and blossoms. It is worthy of remark, that those shoots which form fruit, flower, or seed buds, have seldom if ever any second growth; but remain without increasing in length until the next spring. The midsummer growth is almost always confined to those branches which carry wood buds only. After the second growth is completed, the effects of the descending sap in the formation of new bark and wood is very apparent in the healing up of wounded parts of the stem and branches, which now proceeds with more activity than during any other period of the year. Branches pruned off after the midsummer flow, seldom are followed by shoots from the edges of the wounds caused by their removal, which always happens, more or less, when pruning is performed on free growing trees after the fall of the leaf, and before the full development of the spring shoots and leaves: it is to be observed, however, that the reproduction of branches from the edges of a wound is greatly assisted by leaving a portion of the branch or shoot, or its parent branch or stem, but impeded when a branch is pruned off close to the stem. What was before stated regarding the offices of the pith and medullary rays in originating the buds of shoots and branches, will be confirmed by these facts.

Food of Plants.—Those substances which the roots of plants take up from the soil, and those which the leaves or green system of the plant inhale or imbibe from atmospheric air are comprehended under the name of the food of plants. This part of vegetable physiology has long engaged the anxious inquiries of science, as well as of practice. The question is one of much importance, inasmuch as a perfect knowledge of what constitutes the food of plants generally, and individually, would with unerring certainty point out the means of fertilizing soils, defective in any respect for bringing to perfection the species of tree most desired; would indicate at the same time the most proper substances to be used with the greatest advantage, the exact proportions in which they should be mixed, the mode of applying them, and the best process of manual culture or working the soil, for elaborating and preparing them for absorption by the roots. Of late years great progress has been made in the investigation of this part of vegetable physiology; the labours of T. A. Knight and M. Dutrochet are, in particular, highly valuable, but much still is required before even an approximation to the solution of this important question can be attained. The structure of the root shewed us that whatever kinds of substances are conveyed or by it introduced into the plant, such substances must be in a minute state of division, or dissolved in water. The analysis of a soil demonstrates the soluble substances it contains. These have been found to be chiefly vegetable extract, combined with smaller proportions of a few of the neutral salts, as sulphates of potash and lime, muriates of lime and soda, or common salt; this last, in every instance of our own individual experience, is always in a larger proportion to the other saline matters, and is never altogether wanting, as is the case sometimes with the sulphates and muriates of lime. The vegetable extract, except as regards its presence in poor clays and siliceous sands*, is always in a

* The soils here alluded to, the results of whose chemical examinations have led to the above conclusions, were of almost every kind or description to be met with in practice, comprising the various degrees of fertility intermediate between the poorest sand and the most tenacious clay.

larger proportion to the saline matters. It contains the elements of which the substance of a tree is composed, viz., carbon, oxygen, hydrogen, and azote. The extract, however, obtained from soils is never perfectly pure, but is always more or less (in all our experience) combined with mucilage, and frequently with soluble animal matters. In alluvial soils distinguished for fertility, the soluble extract is found in the largest proportion; five parts of vegetable extract in four hundred of the soil is considered the maximum for healthy vegetation.

The soils called alluvial have the power, it is evident, of preserving this substance in the decomposing vegetable matters which supply it, and of giving it out to the roots of plants, or rather to the water of the soil, slowly, but in that seasonable and regular manner which is the most conducive to the healthy exercise of the functions of the roots. It is evident that in some alluvial soils this extractive vegetable matter must have remained from a remote period uninjured for the purposes of vegetation *. In siliceous, sandy, and gravelly soils, the reverse of this takes place, for the manures applied to these is speedily decomposed, and the extractive matter given out, comparatively, at once: hence the constant repetition of manures required by these kinds of soil to keep them productive. When clay, mild lime, or chalk, fine siliceous and calcareous sand, and impalpable vegetable matters are so intimately combined as to constitute what is termed the best loam, the extractive matter, whether of long duration in the soil or in recently supplied manure, is economized and given out to water, and to the roots of plants, in a similar degree of effectiveness as in the alluvial soil: on the contrary, when clay is the chief earthy ingredient of a soil, the vegetable matter is either retained in the manure, or given out partially; the lower temperature of the clay, its great adhesive powers, and compact texture, uniting to produce this result †. The food of plants supplied by atmospheric air, whatever proportion it may bear to that supplied by the soil, is at least equally essential to the growth of plants, for they can no more exist without that, than they can exist without the soil. The curious structure of the leaves shews how admirably they are

* Extractive matter, when separated from the saline compounds with which it is usually accompanied in soils and in vegetable manures, and exposed to the air, soon decomposes or putrifies. It also loses its solubility in water after two or three solutions in and evaporations of the water. It is a constituent of the nutritive matter of the food of the larger domestic animals, but in the process of digestion it is not retained in the body of the animal for the purposes of life, but is voided with the fæces. The pasture grasses, corn, or annual grasses, green or soiling plants, as clovers, lucerne, sainfoin, vetches, turnips, mangel wurzel, and carrots, all contain extract as an essential constituent, which, with the woody fibre and saline matters of the vegetable, are returned again to the soil.

† The great benefit resulting to clayey soils from the process of paring and burning, is that of improving their texture, and, even in some degree, their temperature or latent heat. A certain degree of what may be called a circulation of the water and air of a soil is essential to its power of preparing the food of plants depending on the soil. Where this power is wanting, as in the case of a perfectly stagnant clay or peat, or a sandy soil, with a subsoil impervious to water, vegetable matter, however ample, in these soils will remain inert and afford no support to trees, or, at least, they will not long exist if planted under such circumstances. So obvious is the effect of this principle of circulation of water and air, (if we may be allowed the expression,) that some have undertaken to prove that the fertility of soils depended on it alone, and that water and air constitute the sole food of plants; and that even animal and vegetable matters were no farther useful than as contributing to the temperature and texture of the soil, fitting it for the more ready circulation of these, and more readily presenting them to the roots of plants. However erroneous the conclusion may be, the principle of practice inculcated by it is essential to the successful cultivation of trees, for on it depend the processes of paring and burning, draining, trenching, digging, and in a word the judicious adoption of the various means which are employed for pulverizing and comminuting soils.

fitted to imbibe air and moisture. The essential constituents of atmospherical air are oxygen and nitrogen or azote; and it holds in solution carbonic acid gas and water; they are elastic and invisible, but can be separated from each other, and their bulk, or volume, and weight can be determined, and their properties satisfactorily ascertained *. Oxygen has received the name of pure or vital air, because animals cannot respire if the air they breathe be deprived of it, nor can seeds vegetate unless it be present in the soil and air in which they are placed. It enters into the composition of the vegetable and most other acids, and largely into that of sugar and extract. It forms about one-fifth of the air of the atmosphere. Carbonic acid gas constitutes about a thousandth part of atmospherical air, its basis carbon is well known in the state of charcoal, and is the fundamental constituent of wood. Nitrogen, or azote, constitutes about four-fifths of the atmospherical air. Its offices have not been so clearly discovered: with much reason, however, it appears to be employed in the formation of several products of vegetation, as gluten and albumen, and in modifying the actions of the other components of the air. It is remarkable that carbonic acid gas being so largely produced by numerous artificial and natural processes constantly going on, as in the putrefaction of substances of every kind, in fermentation, combustion, respiration of animals, and, during darkness, by the green system of the whole vegetable kingdom, so small a portion only of it should be found permanent in the air, varying from $\frac{1}{500}$ to $\frac{1}{1000}$ part as the minimum and maximum. It is heavier than the other constituents of air, and it is lost from the atmosphere, or from wherever it may exist in plants only, and forms the bulk or basis of every kind of wood; it must be at present considered as being largely taken up by the roots of plants. Water, the last mentioned constituent of atmospheric air, enters into it in the state of vapour. The quantity of it suspended in the air is supposed to

* The elasticity of the constituents of atmospheric air is so powerful, that when, from local causes, one ingredient is generated in undue proportion to the others, the most perfect analysis of the general air in the immediate neighbourhood of the spot where this circumstance happens cannot detect any difference in the proportions of the proper constituents from that of the air of the most healthy region. The atmosphere of a crowded city and that of an open or moderately sheltered alpine region, afford by analysis the like number and proportion of ingredients or elements; but notwithstanding this, the influence of the air of these two situations on vegetation is very different. There are certain plants which will not grow in the atmosphere of a crowded city, and there are others which thrive in the former, and will not continue long in that of an alpine air. Some of the following plants grow freely in the atmosphere of the crowded parts of the city of London.

Plants that grow freely.
Sycamore.
Elms.
Mulberries
Ivies
Virginian Creepers
Vines
Oriental Planes, bulbous and tuberous-rooted plants, except Snowdrops.

Plants that exist for only a few years in perfect health.
Laburnum.

That exist in health only a limited time.
Privets
China Roses
Alpine Plants, scarcely ever produce flowers.

Since the above list was written, the Bedford Conservatory, or new flower and plant market, Covent Garden, London, has been erected by John Duke of Bedford, and this interesting feature to the ornament of the metropolis will afford extensive means to determine what species of hardy as well as of tender plants will thrive in the atmosphere of so large and crowded a city as that of London. Since this part of the market was completed in the month of June last year, the following plants may be mentioned as having thriven best. The orange, *Citrus aurantium*; camellia, *Camellia Japonica;* rhododendrons, *R. ponticum, R. maximum, R. punctatum.* Some kinds of pelargoniums, *Geraniaceæ*, Heaths, particularly *Erica tubiflora, E. cylindrica, E. persoluta, E. cupressina, E. odorarosa; Acacia verticillata, A. armata, Epachris grandiflora, E. pungens rosea.*

vary from $\frac{1}{60}$ to $\frac{1}{300}$ part of the atmosphere, being greater as the weather is dry and hot, at which time it is most useful to the growth and health of plants, being absorbed by the leaves *. It is clear that water constitutes immeasurably the largest portion of what is taken up by the roots and furnished to the plant by the soil; and when it is considered that water is composed of oxygen and hydrogen, it cannot be supposed to act merely as a vehicle of the food of the tree; it contributes, probably, to the increase of the solid parts of the living structure by decomposition into its elements, through the agency of the vital powers.

Such are the general facts disclosed by chemical examinations of the soil and atmospherical air, with respect to the substances supplied by them to plants as food. An analysis of the sap itself immediately after its absorption by the spongeols of the rootlets, and before it enters the ascending vessels of the alburnum,† would probably leave nothing more to be desired on this important subject, that might apply to the operations of the practical planter. The sap hitherto examined chemically, has been taken from the alburnum of the tree, and consequently after it had undergone a change in its original constitution, or that which characterised it at the moment of its entering the spongeols of the rootlets immediately from the soil. That the sap undergoes a change in the ascending vessels of the alburnum before it is acted upon by the leaves, has been proved by Knight and others. In these instances, the sap extracted from the lower part of the tree, contained much less saccharine matter, than that taken from a more elevated part of the stem. According to Vauquelin, water, extract, mucilage, sugar, and acetic acid, combined with potash or lime, are found in sap taken from the alburnum or ascending sap vessels of the birch, elm, and beech; but these vary in the sap of different species of trees. Saccharine matter is most abundant in the birch and sugar maple. These results, however, afford but little light in the investigation of the question, as we know that the same sap which produces the acid, astringent crab, produces also the saccharine, aromatic pippin. By the action of heat, light, air, and the peculiar organic structure in different species of trees, under the influence of the vital power, are those substances which are soluble in water, or saccharine and mucilaginous fluids converted into insoluble or resinous and oily substances.

* The value of vapour in air to the health of plants, is well known and appreciated by every skilful cultivator of tropical plants in an artificial atmosphere, as well as by the successful forcing fruit and flower gardener in the hothouse. Plants are enabled by vapour in the air to withstand the effects of extreme heat and drought, which otherwise would destroy the organization of the leaves. We ourselves have found the leaves of the province rose, when in an artificial atmosphere, at an early season (and when its vital powers could not be so strongly exerted, as when under the circumstances of its natural season of growth and exposure) to unfold and increase in healthy growth when subjected for a certain time, each day for the space of a fortnight, to hot air strongly charged with vapour, while leaves of the same species did not unfold, or when unfolded previously to the application, shrivelled up and perished under the application of a dry current of air, of the like temperature, and though all other circumstances were equal.

† The rapid communication which exists between the spongeols of the rootlets and the leaves at the extremity of the tree, as evidenced by the sudden effects produced on the latter by the application of water to the roots of a tree whose leaves have become flaccid or drooping from the want of it, warrants the idea that the ascent of fluids from the roots to the leaves is more direct than our knowledge of the structure of the vessels will allow, or that a principle exists in the vegetable structure analogous to that of the irritability of the animal fibre. The well known experiments of Hales to ascertain the force with which the sap of trees ascends, shew that the sap of a vine branch four or five years old rises with a force considerably superior to atmospherical pressure. Plants having the leaves firm and glossy, exhibited proportionally less force in their ascending sap. Vide *Vegetable Statics*, vol. I., p. 114.

From these facts we may conclude that soluble substances, chiefly vegetable extract, mucilage and carbon, with water as a vehicle and a component, presented to the roots of plants under circumstances varying according to the chemical constitution, and mechanical texture of soils, adapted to the peculiar habits or natural wants of different species of trees, as the oak for instance, and the larch, constitute the food of trees supplied by the soil to the roots; and that atmospheric air of a certain temperature, and degree of moisture, and with freedom of circulation, constitutes that other essential part of the nourishment of trees, which is taken up by the leaves or green system of the plant.

Air, like water, requires a certain freedom from stagnation or confinement to render its nourishing and invigorating properties available to the leaves of trees; when comparatively stagnant, its valuable properties become lost to plants. This is indicated by the disappearance of the green colour from the leaves, which soon drop off, and are not reproduced, but the branches die; a few remaining alive at the top of the stem, may continue the existence of the tree for a few years, but without adding to its girth or solidity of contents. These are the invariable effects of stagnant air, the most common and indeed the only cause of which in plantations is the neglect of seasonable *thinning* of the trees, and the removal of dead and decaying vegetable matter as it is produced.

The putrefactive fermentation of spray and brushwood left in close plantations where the circulation of the air is confined, produces fetid gaseous matters, alike hurtful to animal and to vegetable life; the growth of moss on the bark of trees is promoted by it, and whenever this becomes general in a plantation, the progress of the trees is greatly retarded. We cannot better illustrate the importance of attending to this principle of practice in the planter's art, than by stating an instance kindly communicated to us by high authority * on the subject: in many places over an extent of upwards of a thousand acres of the plantations at Blair Adam the prunings of spray and brushwood, and the loppings of the trees thinned out, for which there is no sale in this country, had been allowed to accumulate for many years. The injurious effect was so remarkable, that the proprietor determined to have the accumulation removed. This was done at an expense not very considerable. Ever since the accumulation has been prevented by having a squad of women and boys, to clear away and brush after the woodcutters or pruners. The expense of this operation has been overpaid by the increase of growth, and it is evident that it has added greatly to the value and beauty of the woods, as well as to the growth of underwood †.

To have entered more minutely into the details of the vegetable physiology would have been incompatible with the scope and design of this essay, and to have dwelt less on those principles which bear directly upon every operation of the planter's art, would have rendered the practical details which follow, more obscure and less instructive.

* The Right Hon. Lord Chief Commissioner Adam.

† We have had the gratification lately of examining a considerable part of these plantations, and at the same time of witnessing the triumph of art in rearing valuable timber on situations of great elevation, and in many places more or less elevated, in which wet and undrained land presented difficulties to be encountered and overcome.

Chapter III.

Of the different modes of rearing forest-trees:—By sowing the seeds on the spot where they are to remain for timber. By sowing the seeds on nursery beds, and afterwards transplanting the young trees to their timber sites. Modes of propagating and of transplanting, preserving, and training, proper shoots or suckers produced by coppice roots or stools. Comparative advantages and disadvantages of the different modes; and of simple and mixed plantations.

Before the seeds of forest-trees are sown on the spots where the plants are to remain for the produce of timber, or the young trees are transplanted from nursery beds to their timber sites, the land should be fenced and properly prepared for their reception. As fences, however, are constructed of various materials, turf, or earth, stones, wood, and thorns, or other armed shrubs, and the judicious adoption of the best kind of fence depending on local circumstances, this part of the subject, perhaps, may be more conveniently discussed under a separate head. It has been supposed, with good reason, but certainly without the evidence of such clear and undisputable facts as are absolutely necessary to bring full conviction to practical men, that when forest-trees are reared immediately from seed, and consequently whose tap roots, proper roots, and rootlets have never been disturbed or curtailed, they grow faster, attain to earlier maturity, and produce sounder timber, than such as are transplanted from nurseries. The facts brought forward respecting the structure and growth of trees confirm this opinion; but when useful or profitable planting is the object of the planter, it is necessary to inquire whether these apparent advantages are not lost for the most part, or entirely, in the extra cost or expense which attends the execution of this method, in comparison to that of transplanting; or whether the extra feet of timber, that may be thus gained, will repay with profit the increased cost of production. A detail of the different processes of these two first-mentioned modes of rearing forest-trees may assist materially in coming to a just conclusion on this important question. The oak being one of the most valuable of forest-trees, and its roots penetrating more directly, and to a greater depth in the subsoil than those of any other tree approximating to it in value, it has been thought to suffer great injury by transplanting, and has, therefore, been chiefly insisted upon to be raised immediately from seed on its timber site.

Should the land on which it is intended to rear oak immediately from seed, be not in a clear state of tillage, it must be brought into that state by the most eligible means; these, of course, will depend on the nature of the soil and condition of its surface. If the soil to be sown is clayey and tenacious, retentive of moisture, and covered with coarse plants, as sedges (carix), rushes (juncus), thistles (carduus), and turfy hair-grass (aira cæspitosa), the surface should be pared and burnt, the ashes carefully applied, and the soil ploughed as deep as the nature of the subsoil will permit. It should have a clear out summer fallow, with repetitions of cross ploughings and harrowings, as often as is necessary, to bring the land to a friable and deep tilth. It should be ploughed into ridges twelve feet wide, sufficiently high to give an inclination from the crowns of the ridges on each hand to carry off all surface water, and be well water-furrowed. A dressing should be applied of compost of dung, coal ashes, road scrapings, sand, &c., or any other manure that can be procured, which may have a tendency to divide the texture of the tenacious soil, and make the tilth friable and deep. This part of the process will be found highly useful, and also necessary to insure a well-founded hope

of success. An application of lime, when it can be procured at a reasonable cost, will also be found highly useful.

Should the effects of these operations have been powerful enough to bring the land to the essential condition of cleanness, depth, and fineness of tilth required, the soil will be ready for the reception of the acorns in the spring. Unreclaimed lands, however, of this description can seldom be prepared as above by the out summer's fallow only; and in such cases it will be necessary to continue the process of fallowing for another season. A green crop fallow may be now adopted; and should the weather be favourable, the crop will probably cover the expense of cleaning for that season, or at all events considerably lessen the cost of fallowing. The choice of the crop to be employed must be determined by the condition or adaptation of the soil to certain kinds of green crops, and the greater local demand that may be for one kind of produce more than another. The following may be pointed out: Swedish turnips, rape, potatoes, cabbages, and winter vetches. For these crops it may be unnecessary to add, that the row and ridge system of culture should be adopted, as affording the greatest facilities for cleaning and pulverizing the land, either by the hand or horse-hoe, and thereby obtaining the great objects in view in their most perfect state, and at the least comparative cost. Green crops are here mentioned for fallow, because they exhaust the soil less than corn crops, and also afford the means of destroying every kind of weed much better; but if a corn crop should promise better advantages than a green crop, and secure the cleaning and pulverization of the soil, there can be no possible objection to it, the extra manure given with the corn crop supplying the loss supposed to be caused to the soil. As soon as the crop, of whatever kind, is reaped and carried, advantage should be taken of the first favourable weather to have the surface scarified, horse-hoed, or skim coulter ploughed (according to circumstances of convenience, in the possession of one or other of these implements), and the weeds collected by the harrow, and by the hand if necessary. It is, in this case, the safest mode to burn the weeds, for their seeds and the eggs of insects are thereby more certainly destroyed. The land should now be ploughed up to stand the winter's exposure. The mode of ploughing is of importance at all times, but most particularly so when the full effect of frost and winter weather is required to divide and ameliorate an adhesive clayey soil. When the furrow slice of a soil of this description is reversed, or laid quite flat, the weight and tenacity of the soil consolidate its surface almost immediately, and obstruct the action of the weather in breaking down the texture of the soil, as well as that of the harrows in raising a tilth, or the greatest depth of mould for covering the seeds. But when the furrow slice is raised up so as to lie at about an angle of 45°, the greatest possible surface of the soil that ploughing can accomplish is exposed to the direct influence of the atmosphere in the most effective manner*. As soon as the weather will permit in February, the harrows should be used to raise as deep a tilth as possible; and when this mould is in its driest state, the last ploughing should be given: the reversing of this comparatively dry and ameliorated mould to the bottom of the staple of the soil is of great advantage to the growth of the plants.

* 'Hally's plough' is admirably constructed for this mode of ploughing.

It may be supposed that the preparation of the soil has here been too minutely dwelt upon; but being a part of the subject of considerable importance, in many instances too little attended to, and from the neglect of which failures of considerable extent have had their origin, as regards this mode of rearing oak trees, we have ventured to state thus much on the point.

By the beginning of March favourable weather will have occurred to use the harrows so as to obtain a proper depth of surface mould in which to sow the seeds; but it is essential that the greatest possible depth of mould be obtained, though the time of sowing be delayed until the middle of that month, but which should be avoided if possible.

There are two distinct varieties of the British oak, differing in the quality of the timber and quickness of growth. In collecting the acorns for sowing, therefore, it is of consequence to select those of the most valuable variety. The discriminating characters of these will be pointed out hereafter, when we enumerate all the different species and varieties of forest-trees: here it will be sufficient to mention, that the most valuable variety of the oak is distinguished by having the acorns on footstalks (*Quercus Robur pedunculata*), and the less valuable variety by bearing the acorns without footstalks (*Quercus Robur Sessiliflora*). If it were possible to have the land in a fit state for sowing in autumn, as soon as the acorns were ripe, and the attacks of mice, birds, and insects upon them could be securely guarded against during the winter, the autumn would be doubtless the most favourable season for sowing; but as this can seldom be done, the acorns must be carefully preserved until spring, by spreading them out in a thin layer on a dry, cool floor. When placed in sand, unless the same be perfectly dry, the acorns are apt to vegetate; and the same thing happens when they are placed in heaps, or in too thick a layer.

The land being thus prepared for the reception of the seed, and the acorns ready, drills or furrows should be drawn with the hand-hoe two inches deep, and at intervals of four feet. In order that the rows of plants may not obstruct the surface-water from passing off by the declining sides of the ridges, a point of great importance in this kind of soil; the furrows for the seed should be at right angles to the ridges. The one-horse drill which, under other circumstances, would be the most economical mode of drawing the drills, is inconvenient here, on account of the curve of the ridges and the open drains in the furrows, over which the drill would have to pass*. The acorns should be dropped in the furrows at about two inches apart: this thick sowing is to guard against the numberless casualties which thin them in the course of their vegetation in an exposed field or common, and also to allow the selection of the strongest seedlings to stand for timber—a part of the duty of the planter requiring great attention, and which hitherto has scarcely been attended to, or but incidentally. The acorns should be carefully covered with two inches depth of mould. The back of a large wood-rake will be found to fill up the drills effectually and with dispatch. As soon as the young plants appear above ground, the soil should be hoed, and every appearance of weeds destroyed. Hand hoeing must be repeated as often as weeds appear, or the surface of the ground becomes hardened; in fact the land must be kept in as clean a state, and as free from weeds, as the best managed seedling beds in a nursery garden, or disappointment and failure in a greater or less degree is certain to follow. The surface of a soil of this description, as regards the successful germination of seeds and growth of seedling plants, requires to be kept always in a friable, loose state; for if once it becomes hardened and cracks, the seedling plants will be injured, their leaves assume a pale sickly hue, and their growth will be greatly retarded. Where the plants are suffered to remain long in this state, the sap vessels become contracted in the bark and leaves, and the plants never regain that vigour of constitution which, in this stage of their growth, is so essential to their future perfec-

* These drains are recommended to be made immediately after the ridges are formed, that the land may have the benefit of their free action a twelvemonth at least before the sowing of the seeds.

tion. The stem and branches remain stationary, until the roots, by the influence of a favourable season or two, sometimes force a new stem from the base of the stinted one, which in the course of one year overtops it, and becomes the stem or body of the tree; the original stem, taking the place of a secondary branch, soon disappears altogether. This is the invariable consequence when the growth of the plant, under these circumstances, is left to the unassisted efforts of nature—a fact upon which is founded the practice of cutting down to the surface of the ground stinted young plants, in order to produce superior stems, which always succeeds with the oak, chestnut, and ash, but never with coniferous trees of pine and fir.

During the summer of the second year, the plants which have escaped the attacks of the enemies before alluded to will be strongly marked in the rows, and the horse-hoe may now in consequence be substituted for the hand-hoe: this will be found very beneficial as attaining the great objects of perfect weeding, pulverizing, and rendering friable and porous the surface of the soil at a diminished expense. The rows, however, will require to be looked over and handweeded with care.

Should the plants stand nearer to each other than one foot, they must be thinned out to that distance in the spring of the third year of their growth. In this process it is of the utmost importance that the smaller and least healthy looking plants should be taken out, and those left which indicate the possession of a vigorous constitution, without regard to the mere circumstance of exact distances. When a plant has a robust stem, clear bark, and a plump leading bud, we may consider it as certain to produce a fine tree, or to contend with most success against natural defects of soil and climate, and accidental injuries. To protect young oaks against uncongenial climates, the best method is to plant nurse-trees of quick growth, and well adapted to the soil, amongst them. An artificial climate is thus produced, and to a certain extent, also, the soil is ameliorated by the roots of these nurse-trees running near its surface, while the oak has its roots obtaining nourishment from below; the former, acting as drains, assist the growth of the oak, until its own roots and stem have acquired sufficient strength and dimensions to resist with effect the various unfavourable circumstances above alluded to. In soils suitable to oak this is not always necessary; but deficiencies of soil and climate are generally remedied by the judicious planting of nurse-trees, of which we shall treat more particularly hereafter. The keeping down of the weeds, and the pulverizing of the soil by the hoe, being unwearedly attended to, the young trees will make rapid progress, and will require to be thinned out to four or five feet on an average in the rows, in the fifth year from sowing, when they will have reached that period at which the opposite and more general practice, that of transplanting from seed beds to the timber sites, begins; and as the subsequent culture, pruning and thinning, is the same in both instances, to be treated of separately, we shall proceed to consider the rearing of forest trees by transplanting. No greater error exists in the planter's art than the doctrine that trees should be raised on the same quality of soil as that to which they are to be transplanted,—as if a robust, healthy plant were less likely to withstand its subsequent casualties of situation, soil, and local climate, than a weaker plant with contracted sap vessels—the invariable consequence of a poor seed-bed soil. What is the intention of all the various processes of culture which have been just described as essentially necessary to the raising of oak from the acorn on a damp, cold, clayey soil, but to *enrich* the soil, and render the seedling plants vigorous and healthy? and with how much less labour and expense can this be effected in a nursery bed of clean fresh soil, of whatever nature or texture, than on the extensive site of an intended plantation of forest trees?

Experience fully confirms that principle of vegetable physiology which teaches that robust, healthy plants, whether in the seedling stage of growth or of a larger size, succeed better than those of stinted growth, even when transplanted to the least favourable soil and exposure.*

Where the land to be planted with forest-trees is an extensive tract and remotely situated, and where the seeds of the several kinds can be procured genuine, of good quality, and at a small cost, the formation of a private nursery may be advisable; but where the plants can be procured from a reasonable distance, it will be found the most economical and effective to purchase them from the nurseryman, and even in the former case one or two years' seedlings should be procured in place of seeds, as a saving of time and expense. The following are essential points to be considered in establishing an effective nursery: fencing, shelter, aspect, soil, and management. The fence of a forest-tree nursery requires to be *rabbit-proof*, or loss and disappointment are almost certain to follow. A foundation of brick-work should be made for a superstructure of close paling. Where shelter is not an object, a very cheap and excellent substitute is found in iron wire-netting, which is manufactured for the general purposes of fences to young plants. *Shelter* is indispensable to the free growth of seedling plants, the injurious consequences resulting to which from sudden checks have already been mentioned, as also the bad effects of confined air to the health and prosperity of trees in every stage of growth; and therefore, at the same time that a full protection against cold, bleak winds and unfavourable aspects is necessary, a full and free circulation of atmospheric air must be secured, to allow of a well-grounded hope of success.

The *soil* of the nursery must be of an intermediate quality as to moisture and dryness, not less than eighteen inches deep to the subsoil, and under a south, east, or west exposure, or intermediate points of these. The varieties of soil required for particular kinds of trees will have to be supplied where the natural soil is deficient, as has already been specified when speaking of the seeds of trees. (p. 13.)

Management.—This head comprehends an ample degree of practical skill in the superintendent and workmen; the erection of proper sheds, the means of carriage for composts, soils, plants, &c., immediately when needed. A quantity of compost and different soils should always be in readiness when wanted for the seedling beds, layer stools, and cutting beds, and a proper assortment of nursery garden tools, which shall be specified hereafter. The preparation of the soil, the mode of sowing, and the different kinds of forest-tree seeds, have already been described. All kinds of forest trees, however, are not raised from seeds, either because

* It is difficult to give a definition of what is termed a *robust, healthy plant*, so as to apply to every species of tree wherein the habits of growth vary in every individual species. The points of excellence cannot be estimated statically, or by weight and measure, but comparatively. A number of minute discriminating characters, collectively, are readily distinguished by the eye, but when taken separately cannot be usefully described in words. A robust, healthy plant, not exceeding five years' growth, may be said to have equally divided roots, the principal ones of moderate length well furnished with secondary rootlets, and these with numerous fibres; the stem straight, and possessing a girth or diameter proportionate to its length; the bark clean, with an epidermis on the young wood exhibiting fissures, as if bursting or giving way to the increasing size of the parenchyma, particularly in the season of spring or autumn; the buds full in size and not crowded; the leaves perfectly shaped, and of the natural colour. The opposite of this state, from the effects of a poor or ungenial soil, exhibits all these characteristics in a diminished form and number; the opposite extreme or unhealthy state of a plant, from the effects of over-richness of soil, may be supposed; for in our experience we have never met with an instance of the kind, to have all these parts of the structure in an enlarged excess.

they do not perfect a sufficient quantity for the general purposes of propagation, or are accidental varieties only of a species losing their characters of distinction when reproduced from seed. The following modes of propagation are found effectual when seeds cannot be obtained: first by *suckers*, second by *layers*, third by *cuttings*, and fourth by *grafting*.

1st. *Suckers* are shoots produced by the creeping roots of a tree, which, when separated from the parent root and transplanted, become perfect trees. They are generally sufficiently rooted in the first season of their production, and they should not be suffered to remain longer than two seasons attached to the root of the tree; for if continued longer, the support they derive from the parent root prevents them from making independent roots of their own in such abundance as they do when separated or taken up at an earlier period. The spring is the most proper season for taking them from the parent roots. When a sufficient number of rootlets appear on the sucker, no part of the root from whence the sucker sprang should be left attached to it; but where the proper rootlets are deficient in number, a small portion of the parent root may be left with advantage. The plants should be planted in rows in fresh soil, and treated in all respects afterwards as directed for seedling transplanted trees. The kinds of trees chiefly reared in this mode are:

The abele tree, *Populus alba.*
Common white poplar, *Populus canescens.*
Aspen, *Populus tremula.*
Chinese ailanthus, *Ailanthus glandulosa.*

The first three kinds may also be propagated by layers.

2nd. *Layers.*—The process of *layering* is well known: it consists in bending a young branch (*a*, *fig.* 2) into the soil to a certain depth, and elevating the top part of it out of the soil in an upright direction; in time the buried part takes root, and the shoot becomes a perfect plant. The root which produces the young shoots for layering is called the stool. Stools are planted about six feet apart every way in a deep fresh soil. The stem at first is either bent down into the ground as a layer, or cut over a few inches from the root. The shoots which are produced from its sides form the layers (*d*). The rooting of the layers is much facilitated by obstructing in part the descending sap; this is essential to some kinds of layers, though not to all: the common laurel, privet, &c., strike root readily without any artificial stoppage of the descending sap. The most expeditious mode of effecting this, is to cut a notch, slanting upwards to the origin of the layer, about half a diameter in length (*f*), and securing the position of the layer in the ground by a wooden peg (*g*). Where the shoot is of a nature that roots with difficulty, it is useful to split the *tongue* of the notch half way up, and to insert a small wedge of potsherd or wood to keep the division open. Rings of wire are also sometimes used for the same purpose, and cutting the bark round the part to within a little of the complete circumference of the shoot. In all ordinary cases, however, the slit or notching mode is perfectly effective. The ground should be kept quite clean of weeds, and watered in dry weather. When sufficiently rooted, the layers should be carefully cut away from the shoots, with all the fibrous roots attached to them, and planted in rows in fresh, well-prepared soil. The stools should have all the stumps of the branches cut away, and left to produce a fresh

fig. 2.

series of shoots for next autumn's layering. The following trees are propagated by layers.

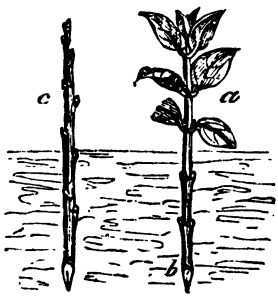
Maple, silver striped maple, *Acer campestre, fol. arg.*
Sir G. Wager's, *A. dasycarpum.*
bastard, *A. hybridum.*
lobe leaved, *A. lobatum.*
mountain, *A. montanum.*
ash leaved, *A. negundo.*
Italian, *A. opalus.*
striped barked, *A. Pennsylvanicum.*
cut leaved, *A. platanoides laciniatum.*
gold striped, *A. pseudoplatanus, fol. aur.*
silver striped, *A. pseudoplat. fol. arg.*
Tartarian, *A. Tartaricum.*
Montpellier, *A. monspessulanum.*
Alder, cut leaved, *Alnus laciniata.*
oak leaved, *Al. quercifolia.*
prickly leaved, *Al. glutinosa spinulosa.*
Turkey, *Al. oblongata.*
oval leaved, *Al. oblong. elliptica.*
Birch, daurian, *Betula daurica.*
Canada, *B. lenta.*
black, *B. nigra.*
paper, *B. papyracea*
poplar leaved, *B. populifolia.*
red, *B. rubra.*
Hornbeam, cut leaved, *Carpinus bet. incisa.*
Judas tree, American white flowered, *Cercis silig. fl. alba.*
Date plum tree, *Diospyrus lotus.*
Spindle tree.
gold blotched, *Euonymus Europ. fol. aur.*
silver, *fol. arg.*
white, *fruc. alb.*
pale, *fruc. pal.**
Beech, broad leaved, *Fagus ferruginea.*
purple leaved, *F. sylvatica purpurea.*
copper leaved, *F. sylvatica cuprea.*†
Ash, weeping *Fraxinus pendula.*‡
curled leaved ash, *F. atra*
flowering ash, *F. ornus.*
manna ash, *F. rotundifolia.*
striped barked ash, *F. striata.*
Mulberry, white, *Morus alba.*
common, *M. nigra.*
Tufelo tree, *Nyssa aquatica.*
mountain, *N. montana.*
Bird cherry, *Prunus padus.*
Cornish, *P. pad. rubra.*
Buckthorn, sea, *Rhamnus catharticus.*
Lime tree, white, *Tilia alba.*
broad leaved, *T. Americana.*

* These four trees are of low growth, and only for ornament
† Propagated also by grafting.
‡ When grafted on the common or tall ash, the pendulous branches have a striking effect.

common, *T. Europæa.*
red twigged, *T. Europ. corallina.*
downy leaved, *T. pubescens.*
Elm, English, *U. campestris.*
striped leaved, *U. fol. var.*
Cornish, *U. sativa.*
hornbeam, leaved *U. nemoralis.*
Dutch, *U. suberosa.*

3rd. *Cuttings.*—Shoots of one year's growth are the most proper to be used in this mode of propagating several kinds of forest trees. The shoots should be selected from the most healthy and free-grown branches, and cut into lengths of from six to eighteen inches, according to the kind of tree. If evergreens (*a*, fig. 3), the leaves should be cut off half way up from the root-end of the cutting (*b*). Deciduous trees should have shed their leaves before the cuttings (*c*) are taken from them. The root-ends of the cuttings should be cut finely smooth, and inserted from about a half to three parts of their length into the soil. For every species of cutting, the soil should be light, and composed, at least, of half of fine siliceous sand. There are many species of exotic plants, whose cuttings will only strike root in pure siliceous sand. It need hardly be remarked, that in this mode of propagating, watering is more particularly required to be attended to than in any other. The utility of the sandy nature of the soil consists in its retaining no stagnant moisture, but just sufficient for the wants of the shoot during the process of rooting. As soon as the cuttings are well rooted, if in a light soil of the above description, they should be carefully taken up and transplanted to their proper soil; for although the shoots produce roots more quickly and in greater abundance in the siliceous sandy soil, yet it is unable to support the growth of the plant after the proper functions of the roots begin. Next to that of propagation by seeds, plants may be increased by cuttings more generally than by any other mode: the process, however, requires more time, skill, and attention, than is demanded for rearing trees from suckers, or by layers or grafting, and it is therefore chiefly practised for the increase of exotic ornamental plants; but the following forest trees are most advantageously raised from cuttings:

Fig. 3.

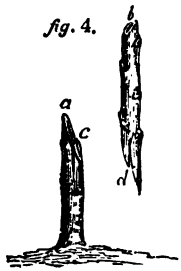


Plane, American, *Platanus occidentalis.*
Spanish var., *P. acerifolia.*
Oriental, *P. orientalis.*
waved leaved, *P. cuneata.*
Poplar, Carolina, *Populus Carolina*
Lombardy, *P. dilatata.*
Athenian, *P. Græca.*
Canadian, *P. monolifera.*
black, *P. nigra.*
weeping, *P. pendula.*
trembling, *P. tremula.*
Maiden-hair tree, *Salisburia adiantifolia.*
Willow tree, common, *Salix alba.*
Peach leaved, *Amygdalina.*

Duke of Bedford's, *Russelliana.*
weeping, *Babylonica.*
round leaved, *Capera.*
gray, *Cineria.*
crack, *Fragilis.*
spear leaved, *Hastata.*
common, *Helix.*
fine stemmed or smooth leaved, *pentandria.*
triandrous, *triandra.*
golden osier, *vitellina**.

4th. *Grafting*, in forest-tree propagation, is chiefly had recourse to for those varieties of trees which lose their distinctive characters when reproduced from seed, and which make finer trees when grafted on free growing stocks of their own species. The scions† take more freely when not more than of one year's growth, but those of much older growth will succeed. The most perfect grafting is where the scion and the part of the stock to which it is to be united are nearly of an equal size, for on the perfect contact of the inner bark of the scion and stock depend the perfect union of the two in the shortest space of time, and consequent equal healing of the wound. The month of March is the best season for forest-tree grafting. The modes of grafting are numerous. French authors enumerate upwards of forty; for the purposes now under consideration, however, that termed *whip* or *tongue* grafting is generally followed. The scions should be selected from the more upright, free-growing branches; the middle portion of the shoot is the best; but where there is a scarcity of grafts, the top and bottom may be used, as these will succeed, though not likely to produce such fine trees. From two to five buds should be left for the production of a leading stem and branches. The stock should be cut in an oblique direction (*a*, fig. 4), and the scion in like manner at a corresponding angle *(b)*; a slit should then be made in the stock about the middle of the wound, passing downwards (*c*), and a similar slit upwards in the scion (*d*); the upper division of the scion made by the slit, termed the *tongue* or *wedge*, is then inserted into the cleft of the stock, and the inner barks of the stock and scion brought into perfect contact, at least on one side. This should be effected with as little delay as possible. The parts are then to be bound with a riband of bass, and particular care should be taken that, in this part of the process, the junction of the two barks is not in the least displaced. To protect the grafted parts from drought and moisture, and from the action of the air, various means have been adopted, but the most direct and useful is well-worked clay, cleaned of gravel or small stones, and horse-droppings, well incorporated and mixed in the proportions of three parts of the former to one of the latter; a little finely-chopped straw is added with advantage. The clay should be

fig. 4.

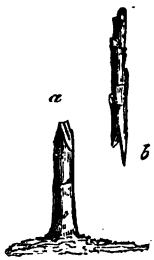


* This numerous and highly interesting tribe of forest plants, from the useful and varied properties which the different species evidently possess, demand more of the notice of the forest planter than they have yet received. The extensive and important trials instituted by John Duke of Bedford, now in progress, to investigate the comparative merit of all the different species of willows, will afford much useful information on the subject.

† Scions may be separated from the parent stock some time before grafting, without suffering injury from being kept, but the root-ends should be placed in earth to prevent the bark from shrivelling. The ascent of the sap in the stock being more advanced in the stock than in the graft, is sometimes advantageous.

placed on the grafted parts an inch thick on every side, and extend about half an inch above and below the union of the stock with the graft*.

fig. 5.



Another mode, called *saddle grafting*, is perhaps better adapted for forest trees than the foregoing, but it takes up more time in the performance. The stock should be cut so as to leave the top in the form of a wedge (*a*, *fig.* 5); the scion split at the lower end, and each side of the incision pared obliquely, so as to form the two divisions into tongue-like processes (*b*); these are then seated on the wedge and made to fit accurately to each side of it. The after operations of tying and claying are the same as in the former mode. The trees which come under the forester's care that require to be reared by grafting are the following:

Broad-leaved evergreen oak, *Quercus ilex latifolia.*
entire leaved, *Q. ilex integrifolia.*
Lucomb's, *Q. Exoniensis.*
Turner's, *Q. Exoniensis Turneri.*
broad-leaved Lucomb's, *Q. Exoniensis latifolius.*
Sweet crab tree, *Pyrus coronaria.*
Siberian crab, *P. prunifolia.*
willow leaved, *P. salicifolia.*
Chinese, *P. spectabilis.*
wild service, *P. terminalis.*
white beam, *P. aria.*
Swedish white beam, *P. aria dentata.*
small fruited crab, *P. baccata.*
Heart-leaved poplar, *Populus candicans.*
various leaved, *P. heterophylla.*
smooth leaved, *P. heter. lævigata.*
Upright medlar, *Mespilus germanica.*
weeping medlar, *M. ger. diffusa.*
Entire leaved ash, *Fraxinus simplicifolia.*
striped barked, *F. striata.*
variegated, *F. variegata.*
white American, *F. Americanus.*
black, *F. Amer. pubescens.*
red, *F. Amer. rubrus.*
Gold striped beech, *Fagus sylvatica fol. aur.*
silver striped, *F. sylv. fol. arg.*
copper coloured, *F. sylv. cuprea.*
purple leaved, *F. sylv. purpurea.*
Gold striped Spanish chestnut, *Castanea vesca, fol. aur.*
silver, *C. ves. fol. arg.*
various leaved, *C. ves. heterophylla.*
shining leaved, *C. ves. lucida.*
Gold striped horse chestnut, *Æsculus hippocastanum, fol. aur.*
silver, *Æ. hipp. fol. arg.*
yellow horsechestnut, *Æ. flava.*
scarlet, *Æ. paria.*

* It is a highly useful practice to draw earth up round the clay so as to cover it entirely from the sun and air.

The stocks for these trees should be raised from seed of the common species, to which each variety is nearest allied, for the nearer the connection of the stock with the graft the more lasting is the union and more perfect the growth. In trees that have been grafted on unsuitable stocks, we frequently see the base of the stem abruptly contracted to a smaller circumference than the upper portion, and *vice versâ*, just as the stock or the graft happens to possess the freest habit of growth. The stocks should be planted in rows two feet apart, and should be one foot distant plant from plant. When arrived at two years of transplanted growth they will be in a fit state to graft. The grafts should be united to the stock as near to the root as convenient. This facilitates the vigorous growth of the tree, and allows of the earth being drawn up on each side to cover the *clayed* portion of the graft. The clay should be removed from the grafts, and the ties or bandages loosened when the progress of the new shoots of the graft indicates the perfect completion of the process. In the spring following that in which the trees were grafted, many of them may be transplanted to their permanent sites; but it is better, as a general rule, to defer transplanting until the second autumn or spring. The *size* of the different kinds of trees most suitable for final transplanting is a point of some importance, particularly when the planting is on a large scale, and where the preservation of every fibre of the roots of the plants cannot be accomplished without an unnecessary expense of time and labour. A very young plant may be readily taken up and transplanted with its roots entire; but a plant of several feet in height requires considerable care in taking it up to preserve its roots from injury. The structure and the functions of the roots of trees, as connected with the produce and support of the plant were before described, and clearly point out the essential use of the minute rootlets and their accompanying spongeols or glands to the nourishment of the plant in every stage of its growth, and under every change of circumstance. Accordingly we find that, if a plant is taken up and transplanted with all its roots entire and uninjured, it experiences scarcely any perceptible check, unless its roots are exposed to the effects of the sun and wind for any considerable time, in which case it makes little, if any progress for a season. A moderate degree of pruning, however, of the overgrown and straggling roots of young trees, possessing the reproductive power in a full degree, and of the branches of their stems, is often expedient, and, when judiciously performed, is beneficial: it prevents the accident of doubling up the roots, or improperly disposing them in the soil, an evil of worse consequences to the plant than the shortening of an overgrown root, or lateral branch. To trees which possess the reproductive power in a very imperfect degree, pruning the roots or branches preparatory to transplanting is injurious. The facility with which young plants of any kind can be taken up without hurting the roots, and the slight pruning which they require at that stage of growth, point out as a general rule in deciding on the most proper size of the different species of trees for final transplanting, that the non-reproductive kinds should be of the smallest size or earliest stage of growth, and those in which the reproductive power is greatest of the largest size. If we divide the stem of a Scotch fir, or a larch, a corresponding stem is not reproduced; but if we cut down, in like manner, a willow, or even a chestnut, or an oak, a vigorous stem will follow. Where the habit of the roots is to divide into large branches, and run deep into the ground, as in the case of the oak, younger plants are required for transplanting than in those instances where the habit of the root is to produce numerous fibres. The nature of the soil also dictates, in some measure, the size of

the plants. In rocky, elevated soils that cannot be ploughed or trenched, nor can allow of proper sized holes being made with the spade, plants of one or two years growth, or such as have small roots, can only be planted: when exposed to severe winds, plants above one foot in height are loosened in the soil, and never prosper. For the purposes of general or extensive works of forest planting, the best sizes of the plants of the different species of trees at the period of transplanting to their timber sites, may be thus enumerated:

1st. NON-REPRODUCTIVE OR RESINOUS TREES.	Height.	
Pinus *abies*, common spruce fir, from	6 to	20 inches.
alba, white spruce.		
rubra, red spruce.		
nigra, black spruce.		
sylvestris, Scotch fir.		
laricis, Corsican fir		24
uncinata, hooked fir		18
pumila, upright coned fir		12
Mughus, nodding coned fir.		
pungens, prickly coned fir.		
Banksiana, Hudson's Bay fir, in pots*		24
Pallasiana, Prof. Pallas's fir.		
pinaster, cluster fir	6	20
pinea, stone pine	6	18
maritima, sea-side pine	6	18
Halepensis, Aleppo pine	6	18
inops, Jersey pine	6	18
resinosa, pitch pine	6	18
variabilis, various leaved pine.		
Clanbrassiliana, dwarf pine.		
tæda, frankincense pine, in pots.		
serotina, fox-tail pine.		
rigida, three-leaved pine	6	20
palustris, swamp pine, in pots.		
longifolia, long leaved pine.		
Cembra, Siberian pine	6	18
strobus, Weymouth	12	36
excelsa, Bhotan, in pots.		
cedrus, Cedar of Lebanon, in pots.		
deodara, Indian cedar.		
pendula, black larch.	6	24
microcorpa, red larch.		
larix, common larch.		
Canadensis, hemlock spruce	9	20
dumosa, bushy pine, in pots.		
taxifolia, yew leaved, in pots.		
picea, silver fir	9	20
spectabilis, purple coned, in pots.		
balsamea, balm of Gilead	9	20
Fraseri, double balsam, in pots.		
adunca, crooked.		
Romana, Roman.		

* By this is meant such sorts of forest-trees as from their rarity, or recent introduction of very small quantities of their seeds, have rendered the utmost care and caution necessary in the first attempt to cultivate them here; by and by, instead of being raised in pots, the seeds may be found to succeed equally well in the open ground.

		Height
Pinus	*Siberica*, Siberian pine	9 to 20 inches.
	pichta, pigmy pine, in pots.	
	orientalis, oriental pine.	
	Lambertiana, Lambert's pine, in pots.	
	ponderosa, heavy wooded.	
Araucaria	*imbricata*, Chili pine.	
Taxodium	*distichum*, deciduous cypress.	
Cupressus	*sempervirens*, upright evergreen cypress.	
	thyoides, white cedar.	
Juniperus	*Virginiana*, red cedar.	
Thuja	*occidentalis*, American arbor-vitæ.	
	orientalis, Chinese.	
	plicata, Nee's.	
	Caroliniana, Lucas's arbor-vitæ.	

2d. REPRODUCTIVE TREES.

	Height.	
Quercus, oak, different species of	from 6 to	30 inches.
Fraxinus, ash, different species of	6	20
Castana, Spanish chestnut	12	30
Æsculus, horse chestnut	12	30
Fagus, beech	6	20
Betula, birch	9	30
Alnus, alder	6	24
Carpinus, hornbeam	6	24
Platanus, plane	12	30
Acer, sycamore	6	30
Maple common	6	24
Norway	6	24
Grafted and layer reared species	12	36
Tilia, lime, common, and others	12	36
Ulmus, elm, wych	9	30
Grafted and layer reared species	18	36
Populus, poplar, different species of	18	36
Salix, willow tree, species of.		

Those species which are mentioned as raised in pots for transplanting, except the cedars and a few others, are as yet considered merely ornamental trees, the period of their introduction not having allowed sufficient time to prove their properties or comparative value as timber trees. It is highly desirable to plant them, with a view to ascertain that point, several of them being highly valuable in their native countries. The pinus Lambertiana has been found to have attained to the growth of 200 feet in height, and 57 feet in circumference*.

Modes of transplanting. Much difference of opinion prevails on the comparative merits of the different methods of planting from time to time introduced, and more or less practised. Trenching is held by some to be essential to success, without considering that there are situations and soils where timber of the most valuable quality may be produced that cannot be dug or trenched. Others again infer, that to insert seedling plants into the soil in its natural state is all that is required for the production of timber and underwood possessing every requisite value.

These opinions are too exclusive; they have led to baneful effects, and still are the cause why many extensive tracts of land lie waste, which otherwise might have been covered with profitable plantations. But in more

* Transactions of the Linnean Society of London, vol. xv. Part II. p. 499.

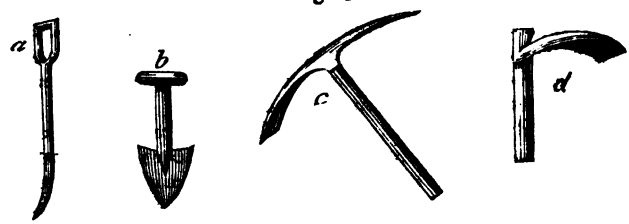
numerous instances, from the same cause, great and unnecessary expenses have been incurred, only to result in a total failure of the plantation, with the consequent loss of time and property. Instances illustrative of these points have been too frequent in the management of the forest lands of the Crown, (which ought to shew an example of practical planting worthy of imitation by the community,) as well as on private estates, to require to be cited here. Well regulated economy in the expense, or first outlay, is one of the principles of the art important to be attended to in practice. Accordingly it is not surprising to find some modes of planting invented, and others misapplied, under the mistaken impression of furthering this principle, at the serious risk of retarding the healthy growth and prosperity of the trees, and of producing results completely subversive of the intention.

The great object of transplanting trees from seed-beds, layer-stools, cutting grounds, &c. to nursery rows, or beds previous to their final transplantation for good, is to increase the number of fibres and rootlets; and, by ensuring the free uninterrupted formation of healthy stems and buds, to lay the foundation of a vigorous constitution in each individual plant before it be finally transplanted to its timber site.

The different modes of planting trees on their timber sites are denominated, first, slit-planting; second, holing or pitting; third, trench-planting; fourth, furrow-planting. There are also varieties of these characterised by the instruments or tools used for inserting the roots of the plants into the soil.

Slit planting is the most simple mode, and is practised on soils in their natural state without, any preparation of holing, ploughing, or trenching. It is performed by three different kinds of instruments: viz. by the *moor planter* (*fig.* 6. *a*), by the diamond dibble (*b*), and by the common garden spade.

Fig. 6.



1st. The *moor planter* (*a*) is a heavy instrument, consisting of a wooden shaft and handle two feet nine inches in length, terminated by a single slightly curved prong of well tempered iron or steel fifteen inches in length, two and a half inches broad at the insertion of the shaft, and gradually tapering to the point. The handle is made sufficiently large to be grasped by both hands, and the operator with one stroke drives the prong into the ground to the depth required for seedling trees, and by depressing the handle, the point of the instrument raises up the earth, leaving a vacuity or opening in loose earth, into which a person, holding a plant in readiness, places the root, and with the foot fixes it in the soil. A stout active workman with this instrument, and the aid of a boy, will transplant a greater number of seedling trees on light moor soils than by any other method at present known.

2d. The *diamond dibble* (*b*) is recommended by Sang*: it is made of a

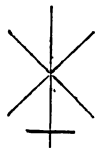
* Planter's Kalendar, p. 170.

triangular shaped plate of steel, furnished with an iron shaft and wooden handle. The sides are each four inches long, and the upper part or side four inches and a half broad. It is used for planting on sandy and gravelly soils where the surface produce of herbage is short. In this case the planter makes the ground ready with the instrument in one hand, and inserts the plant with the other. He carries the plants in a bag or basket suspended from his waist; he strikes the dibble into the ground in a slanting direction so as to direct the point inwards, and, by drawing the handle towards himself, an opening is made, and kept open by the steel plate for the reception of the roots of the plant by the other hand. The instrument is then removed, and the earth made firm about the roots of the plant by a stroke with the heel of the instrument.

3d. By the *spade*, a cut is made in the turf with the spade and crossed by another at a right angle: the two cuts thus made resemble the figure of the letter T. The handle of the spade being depressed backwards forces open the edges of the cuts, and in the opening thus made the roots of the plant are inserted; the spade is then withdrawn, and the turf replaced by pressure with the foot.

Sir John Sinclair describes an improved mode of slit-planting, as follows: The operator with his spade makes three cuts, twelve or fifteen inches long, crossing each other in the centre, at an angle of sixty degrees, the whole having the form of a star. He inserts his spade across one of the rays (*a*), a few inches from the centre, and on the side next himself;

Fig. 7.



a

then bending the handle towards himself and almost to the ground, the earth opening in fissures from the centre in the direction of the cuts that had been made, he, at the same instant, inserts his plant at the point where the spade intersected the ray (*a*), pushing it forward to the centre, and assisting the roots in rambling through the fissures. He then lets down the earth by removing his spade, having compressed it into a compact state with his heel; the operation is finished by adding a little earth with the grass side down, completely covering the fissures, for the purpose of retaining the moisture at the root, and likewise as a top dressing, which greatly encourages the plant to push fresh roots between the swards*.

4th. The defects of the slit mode of planting are, that the earth is not properly reduced in its texture to suit the tender fibres of the roots of seedling plants, and the natural plants of the surface are left to contend with them for the nourishment afforded by the soil, nor can the rootlets of the young trees be disposed and placed in their right positions. The least objectionable practice is to cut a circular piece of the turf, a foot in diameter, and lay it on one side with the surface downwards; the workman then with his spade loosens and breaks down the texture of the uncovered soil, and, by making ample space for the extension of the roots of his plant in every direction, inserts it in the pulverized earth. The turf which had been reversed and laid on one side, is then with a stroke of the spade divided into two equal parts, and replaced on each side of the plant in its reversed position. The reversed turf supports the plant against the effects of the wind, retains the proper moisture of the soil, and prevents the evil consequences resulting to the lateral branches of the young tree, and to the healthy progress of the stem, from the uncontrolled growth of the herbage natural to the soil,—all of which, by the former modes, are rather encouraged than checked. In uninclosed commons or moors, the natural

* General Report of Scotland, vol. ii. p. 283.

herbage and shrubby plants are kept under by cattle, &c.; but when such lands are inclosed for planting, and thereby protected from stock, the natural plants, which before appeared diminutive and slow of growth, suddenly attain a size and vigorous vegetation highly detrimental to the young forest trees.

2. *Mattock* planting is confined chiefly to rocky ground, and to soils containing many coarse, tough roots of herbage, heath, &c.; and under these circumstances the mattock is an indispensable instrument. It is thus described in the Planter's Kalendar:—'The handle is three feet six inches long; the mouth is five inches broad, and is made sharp; the length of it to the eye or shaft is sixteen inches, the small end or pick is seventeen inches long' (*c*, fig. 6). It may be unnecessary to mention that the broad or hoe end should be faced with steel and kept well sharpened; it is perfectly effective in cutting or paring the heath, furze, &c., and the pick end is equally so for thoroughly loosening and fitting the soil to be operated upon with the spade or *planter* (*d*). The *Hackle* prongs are recommended for clayey, tenacious soils*, which are difficult to work with the spade. It is made with two or three prongs; the former of two for the soil just mentioned, and the latter of three prongs for stony or gravelly soils.

3. *Holing.*—Holes or pits are dug out, and the loosened soil left for a season to the action of the weather, to ameliorate and reduce its texture. Time should be afforded for the rotting or decomposition of the turf or surface produce taken off the space which is opened, previous to the period of planting. The size of the holes should vary according to the size of the plants to be planted, and to the nature of the subsoil. Plants from one and a half to two feet high should have the holes two feet wide and eighteen inches deep, prepared in the summer or autumn for the reception of the plants in spring. For trees of larger growth, the extent of the roots must determine the size of the holes, making an allowance of from six inches to a foot of extra width beyond the extreme points of the roots. Holes made in tenacious clays retain the water which falls into them, and rots the roots of the trees; dry, light, sandy soils cannot be benefited by the pulverizing action of the sun and air; rocky soils admit but imperfectly of holing; and some kinds of binding gravelly soils are as liable to the retention of moisture as stiff clays. The practice of holing is therefore never attended with success on these kinds of soil.

Spade planting applies to land prepared for the reception of the plants by trenching. Although this mode of planting is the most common in use, and may appear to require but little exercise of skill on the part of the operator, it is nevertheless often very badly executed. It is best performed when the holes are made a few inches wider than the roots of the plant extend; the earth of the bottom of the hole should be broken down with the spade, the sides all round should be made to slope inwards, so as to cause the bottom to be wider than the top. The person who holds the plant should then place it in the centre of the pit, and the operator with the spade should have ready some fine surface soil to cover the bottom and raise it up to the proper height, the person holding the plant raising it at the same time, so that it may stand not deeper in the soil than it previously stood. The earth should then be carefully thrown in a finely divided state, and the plant during the operation slightly moved, so as to prevent the roots from being covered in bundles, and to afford each root and rootlet to have a portion of soil intervening between it and the rest.

* Pontey's Profitable Planter.

Treading should be avoided, as it renders the soil cohesive, which *in* stiff or heavy land is an evil of great magnitude to newly-planted roots. *In* light soils, however, a slight pressure with the foot to keep the plant steady in its place is necessary, particularly if the weather is dry during the season of planting; but in cases where it is practicable, it is much more beneficial to *settle* the earth about the roots of the plants by a free application of water in the usual manner.

It is the best and most expeditious practice to have one set of men to make the holes, and another to finish the planting. When different species of trees are to be mixed in the plantation, and in unequal proportions, each species is successively distributed and planted. What we have already stated respecting the great importance to the success of the plants of not suffering the roots to be dried by exposure to the sun or wind, may render it unnecessary to urge here, that the distribution of the plants on the ground should not be farther in advance than just to keep the planters fully employed. Before laying the plants out on the spots where they are to be planted, it is a most useful practice to dip the roots in water, or in a puddle made of water and rich mould. In planting on a confined scale, the plants may be distributed as before, and two workmen may proceed to open the pits on the spots. As soon as the hole is opened, one of the operators places the roots of the plant in the hole, while the other with his spade finishes the process as above directed. By this method the holes can be made proportionate to the size of the roots of the different plants, which, when of various species, are oftentimes also of different sizes. When circumstances warrant the previous preparation of the soil necessary to this mode of planting, it should be adopted, as being the most perfect and effective.

Furrow planting is performed by opening a furrow with the trenching plough, or with two common ploughs; the one succeeding the other in the same trench or furrow, and opening it to the depth required by the roots of the trees. The roots being placed in the furrow at the proper distances, the workman with the spade finds no difficulty in obtaining the necessary quantity of pulverized soil to complete the work. This mode of planting has been practised with success on the Duke of Bedford's estates in Bedfordshire, and in Buckinghamshire in the neighbourhood of Woburn. The implement employed was a very strong plough, drawn by six horses, and opening a furrow from twelve to sixteen inches deep, turning the sward or heath over on each side. This was followed by a scuffler or grubber of three tines, which completely stirred and pulverized the soil. On light land eight acres a day was done in this way, but the soil must be light and free from large stones or other obstructions.

That extensive and valuable plantations have been made by *slit* planting there are abundant proofs, and on elevated, thin, light soils incumbent on rock, or where trenching cannot be effected or the furrow plough be used, this mode may be adopted with economy and success. Before planting by this method, however, it is essential to know the precise nature of the subsoil, and that there does not exist a hardened stratum, impervious to water, beneath the surface, which frequently happens in heaths, or siliceous sandy moor lands, it generally consists of the heath-soil in a compact layer about an inch thick, containing a large proportion of oxide of iron, and impervious to water. Beneath, and next to this, is generally grey or white sand, surcharged with water; and whenever trees are planted, by the slit mode, on soils so constituted, they never make any healthy growth, but perish so soon as the roots reach the hardened stratum: trenching, or the furrow plough must be employed in such cases to destroy the impervious

stratum, and render free the circulation of water and air, otherwise the attempt to establish trees will be vain. When the land is clean, friable, moderately deep, free from, and not retentive of stagnant moisture, the mode of planting by holing may be adopted with propriety. Lands of a tenacious, clayey nature, and also those of the best quality, employed for forest planting, ought to be trenched, as being the most economical ultimately, and the most effectual, for these kinds of soil. The preparation of tenacious clayey soils by paring, and burning, and trenching, has already been stated.

Since the above was prepared for the press, we have perused the able tracts * on planting by W. Withers, Esq., of Holt, in Norfolk. This gentleman, besides shewing, by facts not to be doubted, the superior advantages of trenching, compared to that of holing or slit planting, in the more speedy returns of profits from thinnings, and extra annual increase of timber in the trees left for that purpose, has likewise proved the value of manure to *poor* soils in conjunction with this mode of preparation. That such a mode of preparation with the application of manure should be highly advantageous for the growth of the more valuable timber trees on soils of the nature now alluded to, will be instantly seen by every one who has examined carefully the natural habits of these trees by the principles of vegetable physiology already discussed; and such as may feel reluctant, or have not leisure, to employ this mode of arriving at a perfect conviction, may be amply convinced by comparing that soil on which the oak, for instance, or any other of the more valuable timber trees, invariably attains the highest perfection, with that on which it or they are always inferior. Compare the constitution of the soil No. 2, at page 7, with that of the soil No. 5, and the almost total absence of clay, chalk, and vegetable matter, will be evident in the former. Now, on this soil the oak, according to our experience and observation, is never found in a natural state, and, when planted in it, never attains to any value as a timber tree even with the aid, as nurses, of the pine, birch, and sycamore, which here succeed. On the soil No. 5, where the constituents of the soil are different from those of No. 2, the oak attains to the highest perfection. To supply manure, therefore, composed of clay (burnt or recent), chalk, and vegetable matter, or rotten dung, in the requisite proportions, and by deep trenching (remedying, in some measure, the defects of the subsoil), and by combining and comminuting the whole as intimately as possible, the soil No. 2 would approximate to that of No. 5, and the oak might then be planted with a certainty of its successful produce of timber. Any smaller application than the requisite quantities of these ingredients will, of course, give a diminished result as to the crop of timber, but still it will give an increase in proportion to the quantity applied.

The principle on which manure is objected to for the rearing of forest-trees, is, that it will force the growth of the tree beyond its natural state, and render the deposit of vegetable fibre soft, and of diminished strength and durability. This, however, is carrying the point to an extreme to which it is never likely to be in the power of any planter to arrive, were he even willing to attempt it. To manure a poor soil, for it should be here kept in view that this and not a rich, or even moderately rich soil, is intended, can have but one effect, and that is to improve the growth of the trees. But the great, immediate, and important object of manure here, is to furnish a liberal supply of food while the plant is in its first stages of growth, thereby giving it the means to form a strong constitution, enlarg-

* 'A Memoir on the Rearing, &c., of Forest-trees.' 'A Letter to Sir Walter Scott, Bart., &c.' 'A Letter to Sir H. Steuart, Bart., &c.' By W. Withers, of Holt, Norfolk.

ing its number of roots and rootlets, and, at the same time, improving the quality of the exhalations from the soil, for absorption by the leaves, which is, in fact, an amelioration of the local climate or air. All these important points to the health of the tree, to the value of its timber, and to the attainment of the object in view, a valuable return in the shortest space of time for the capital expended, are thus highly promoted, and, in a great measure, secured by trenching, manuring, and keeping clean of weeds or surface culture for a limited period after planting. As an answer to the important question, will the sum expended in trenching and manuring be returned with interest and profit in proportion to those of the lesser sum required for planting on unprepared land, Mr. Withers has brought forward facts and observations to which we shall revert when discussing the subject of the valuation of timber trees.

The proper distances at which young forest trees should be planted on their timber sites depends on the natural habits of growth of the different species, the nature and preparation of the soil, and the size of the plants to be planted.

The larch, spruce, and pine require less space than the oak, chestnut, elm, &c. The nature of the soil will determine the peculiar species of trees which should predominate in the plantation, and point out the distances at which they should be placed. If the soil is thin and of a light texture, the fir tribe should occupy the largest proportion, if not the whole space of land; if clayey, the oak, elm, ash, &c., should be the principal trees in the design; and, if a deep sandy soil, or if the soil be calcareous, elevated land, the beech, hornbeam, &c., ought to have the preference—all with the view to the ultimate produce of timber. The following table may be useful for readily pointing out the number of trees required for a statute acre of land, when planted at any of the undermentioned distances:—

Distance apart.	Number of Plants.	Distance apart.	Number of Plants.
1 foot	43,560	10 feet	435
1½ „	19,360	11 „	360
2 „	10,890	12 „	302
2½ „	6,969	13 „	257
3 „	4,840	14 „	222
3½ „	3,556	15 „	193
4 „	2,722	16 „	170
4½ „	2,232	17 „	150
5 „	1,742	18 „	134
6 „	1,210	19 „	122
7 „	889	20 „	108
8 „	680	25 „	69
9 „	537	30 „	49

In profitable forest-tree planting, the nearest distance at which young trees should be planted on their timber sites, is a yard, or three feet, and the widest space five feet; the medium distance of four feet plant from plant is, or ought to be, that most generally adopted. Seedlings of three years' growth, or plants which have remained two years in the seed-bed and one year in transplanted nursery rows, should be planted on their timber sites three feet apart every way, it being understood at the same time that the soil is thin, light, or sandy, and that the slit or holing in method of planting is used. But should the soil have been prepared by ploughing and trenching, and be in a clean fallow state, the medium distance of four feet, or three and a half feet, if the species of trees to be planted are exclusively of the fir or pine tribe, will be the most proper. Trees of the age now alluded to will vary in size from nine to twenty inches in height, exclusive of some species of poplar, elm, &c., which grow faster than the generality of forest trees. In well-prepared lan dof a deeper surface

soil than the above, plants from eighteen to twenty-four inches in height of the fir tribes may be planted with advantage; and deciduous trees, as the oak, chestnut, elm, &c., from three to four feet in height, may be planted at the distance of five feet apart. In the last case a return of profits from thinnings will be obtained at least two years earlier than from transplanted seedlings, under the like circumstances of soil. Trees planted as nurses for assisting the progress of those intended for timber are of quick growth, and in the course of from seven to twelve years will have attained to a size fit for the purposes of fencing, or to be used as poles, coopers' ware, &c., according to local demand. When the nurse trees have arrived at this stage of growth, they will require to be partially thinned, to make room for the timber trees, or *principals* of the plantation, as they are termed. Whenever the branches of the former interfere with those of the latter, no time should be lost in remedying the evil, by pruning the nurse trees, or cutting them down. If the different operations of planting have been judiciously performed, the value of the trees thinned out at this period will cover the rent of the land, with compound interest on the capital expended in planting it. Hence the importance of nurse trees, and the propriety of furnishing the ground at first with a sufficient number of young plants to be cut down and taken away periodically, until the principal timber trees have attained to maturity. In poor soils, where the original outlay of capital and the rent of the land are both small, the expenditure will be covered by the periodical crop of thinnings, and *vice versa* in better soils, authorizing a larger expenditure in the preparation, in the size of the plants, and in the mode of planting, a comparatively superior number of trees of increased value will be produced at each periodical thinning. These results are certain to follow judicious planting.

The third and last mode of rearing forest trees proposed to be discussed at the head of this chapter, is that of selecting the superior shoots of coppice stools, and training them to full-grown timber trees. The oak, on account of the value of its bark, is more frequently reared in this way than the elm*, ash, and chestnut. The timber of coppice trees is in general faulty, and of inferior quality, to that reared from seeds. Where care, however, is taken in the selection of the shoots from healthy and not over-aged coppice stools, timber of the best quality may be obtained from them.

The produce of coppice stools consists of materials for fence wood, fuel, besoms, &c. Poles and bark are the most valuable of this produce, where the practice is to leave no standards, or saplings for timber. It is, however, perfectly clear, that when a wood or coppice offers to the purchaser produce of various sizes convertible to various uses, along with full-grown timber for navy purposes, the sale is more readily effected, and generally on better terms, than when the produce consists of smaller wood only. In making choice of the shoots of coppice stools to be trained for timber trees, great care should be had to select none but such as are straight and vigorous, and which originate as near to the roots of the stool as possible. The neglect of this latter circumstance is the chief cause of the unsoundness of coppice-reared timber, particularly at the root or *butt* end of the bole. The *parent wood* of coppice stools is most frequently suffered to rise too high from the roots, consequently the shoots emitted from it never grow with so much vigour, or attain to so great a size in a given space of

* *A great part of the elms* (*ulmus campestris*) *reared in Devonshire are from layers, and frequently defective at the most valuable part.—Vide Vancouver's Survey of Devon.*

One or two fertile tracts in Devon, where the soil is of the nature termed red sandstone, is more favourable to the growth of the elm than to any other tree.—*Mr. Kingston.*

time, as when the stool is kept within an inch or two of the surface of the ground. When the parent stool is a foot or more in height from the root, it becomes divided into pointed rugged parts, and if a tiller or shoot, left for a tree, is situated near to one or other of these, the *stub* is in time encompassed by the bark of the young tree wholly or partially, which causes blemish and unsoundness in the timber, as well as obstruction to its prosperous growth. The stumps of coppice stools should, therefore, be cut near to the surface of the ground, and the face of the *stubs* as level and free from fractures as can be. The kinds of trees most profitable for coppice produce are those which possess the reproductive power in the highest degree; these were before enumerated at page 34. It may be unnecessary here to observe that the non-reproductive trees, such as all the pine and fir tribes, are unfit for the purposes of coppice. The shoot, or tiller, being selected with due attention to these essential points, all other shoots belonging to the parent stool should be cut away close to the root. The young tree should then receive the same treatment as other trees reared by seed or transplanting. Although, under any circumstances, it cannot be recommended to convert a coppice wood into a timber grove, nevertheless, should the circumstance of local demand for timber trees be considerable, it is a highly profitable practice to allow a certain number of the most select oak tillers to remain for timber. Should the number finally left to become timber trees not exceed thirty on the space of an acre, the coppice produce will not receive any injury to be put in competition with the value of the trees retained. Were one hundred select tillers left on the cutting or fall of a coppice, and were the periodical falls made at eighteen years intervals of time, on the second cutting these tillers would be thirty-six years old, and worth from 10*s.* to 12*s.* each. At this period of growth twenty-five of the number should be taken away, leaving an average distance between those that remain of about twenty-four feet. At the next fall the trees will have attained to fifty-six years' growth, and will afford seventeen trees to be thinned out, of the value of 22*s.* each. At seventy-two years' growth the value will be increased to 38*s.* each tree, and allowing fifteen trees to be thinned out. At the fourth, or last thinning, the trees will be ninety years of growth, and worth at least 50*s.* each, leaving thirty timber trees, of which a part will be fit for ship-building, and exceed in value the fee-simple of the land. Land requiring a period of eighteen years to produce coppice-wood fit for cutting or a fall, cannot be worth more yearly than 10*s.* per acre in husbandry; consequently the rent of the land and cost of culture of the coppice is covered by these thinnings of the timber trees, leaving periodically the proper coppice produce, and at the termination of one hundred years the valuable trees above mentioned as clear profit.

The age at which coppices should be cut down varies according to the soil and their quickness of growth. Nine years may be considered the shortest period, and thirty years the longest, as oak-bark, which constitutes a valuable part of the produce, does not improve in quality after that age. Eighteen years' growth is about an average period for coppice-wood, and the average returns from bark and wood 21*l.* an acre*.

The comparative merits of the three different modes of rearing forest trees, proposed to be considered at the head of this chapter, will have appeared, from the facts brought forward, to be greatly in favour of transplanting young trees of proper sizes and age, from nursery beds to their timber sites, whether in regard to economy in the first and subse-

* There are instances of coppices affording returns of 50*l.* sterling profit per acre.

quent outlay of capital, in making and rearing the plantation, or in respect to the quantity and quality of timber produced on a given space of land, and in a given space of time. The rearing of oak timber from seed on the spots where the trees are to remain for timber is, however, an exception to the above conclusion under the following restrictions; namely, that the acorns of the best variety of oak (*Quercus robur vel longipedunculata*) can be obtained of good quality, at a reasonable cost, in sufficient quantities; that the land to be sown is in a perfectly clean state of culture, in *good heart* on the surface, and free from stagnant moisture; that labour is cheap; and that ample and complete protection from the attacks of vermin can be ensured to the acorns, and to the seedling plants till they equal in size three years' old nursery plants. When all these circumstances can be combined, then the mode of rearing the oak on its timber site from seed should be adopted, but not otherwise, or disappointment will be certain to follow.

Simple plantations consist of one or two species of trees only; *mixed plantations* of many different species. The latter, on suitable soils, are the most profitable; they afford an earlier, more permanent, and a larger return for capital than simple plantations. The judicious arrangement of the different forest trees, not only promotes the greatest returns of profit from the plantations, but likewise effects the highest embellishment to the estate and surrounding country*.

Shelter in winter and *shade* in summer are also important points. Evergreen trees, and such deciduous ones as retain their leaves to a later period of the year (the hornbeam, beech, and some varieties of the oak) afford much greater shelter in winter and in early spring, when it is most wanted, than those which lose their leaves early in autumn, and should, therefore, be planted wherever shelter is most desired. Shade is best afforded by trees which, rising with naked stems to a certain height, afterwards send out an extended series of branches, as the oak, beech, chestnut, and elm, which can be readily trained to that state by pruning, and their spreading branches and umbrageous foliage are highly superior for this intention than those of the ash, sycamore, plane, &c.

Although mixed planting, as just now observed, is the most profitable, and, under skilful massing and grouping, the most embellishing to the landscape, yet there are certain circumstances connected with the growth of the various species of forest-trees, which, when they occur, effectually control the choice of the planter in his modes of arrangement: these are, first, the peculiar nature of the soil to be planted; secondly, the climate, or the exposure and elevation of the site of the plantation. In planting, soils may be divided into *simple* and *mixed*. The latter allows of the fullest scope to mixed planting. *Simple* soils are those which contain the smallest number of ingredients in their composition, or which consist chiefly of one substance; as sandy soils, containing from nine-tenths of

* Planting the same sort of trees in masses was originally practised at Blair Adam, e. g. Half an acre of oaks, half an acre of beeches, half an acre of elms, half an acre of Spanish chestnuts, &c. This was altered for a mixture of different forest-trees, but Lord Chief Commissioner Adam has resorted recently to the original practice, especially on the sides of hills. His reason for this is, that mixing trees of different sorts (their growths being unequal) leads in thinning to sparing the more forward tree, though the tree of less value: whereas, uniting the same species of tree in masses, insured their growing pretty nearly in an equal degree, so that the choice in thinning secured the preservation of the best growing tree; and with regard to the effect of embellishment, the large masses of different colours, especially on the slope of a hill, appears to have more effect in point of grandeur than intermixture, the latter being more adapted to pleasure-grounds and the woodlands near a residence.

sand (the maximum at which the successful culture of the white field-turnip is supposed to be limited) to one-twentieth, the supposed point of absolute sterility for even common herbage, are properly termed simple sandy soils, and on which the pine, fir, larch, and perhaps the birch, can only be planted. Soils consisting of from seven-eighths to a larger proportion of chalk will rear the beech chiefly; and when the proportion of one-half of vegetable matter to one-half of sand and loam meet in a soil, it is properly simple vegetable earth, and comes under the denomination of peat, of which there are several kinds, but which will be more particularly mentioned under the head of soils. On this last-mentioned soil the planter is chiefly confined to the abele, poplar, and alder: the willow and birch only partially succeed, or when the vegetable matter is in a less proportion to the other ingredients above stated.

The elevation of the site of the intended plantation above the level of the sea, where that is considerable, influences the local climate so much as often to confine the choice of the planter to one or two species of trees only, even though the soil should be otherwise favourable for mixed planting.

It is calculated that an elevation of six hundred feet diminishes the temperature of a site equal to that of one degree of north latitude; the degree of dryness or humidity of the atmosphere, and the force of the winds seem also to increase in proportion to the elevation of the land. Accordingly we find that different species of trees occupy different regions and degrees of elevation on the mountains of the torrid, temperate, and frigid zones.

According to Humboldt, the trees which grow in the highest elevation are the pine and the birch, (these also it may be observed will flourish in the lowest situations, the birch in particular will grow in soils periodically overflowed or covered with water for two or three months in a year). The highest altitude of the growth of the pine is stated to be from twelve thousand to fifteen thousand feet above the level of the sea, in latitude 20°; and the limits of the growth of the oak appears to be confined to ten thousand three hundred. The last species of trees found nearest to the limits of perpetual snow on Mount Caucasus, in latitude 42½°, and on the Pyrenees, are the common birch (*Betula alba*), and the hooked pine (*Pinus uncinata*), and the red spruce fir (*Pinus rubra*). On the Alps, latitude from 45° to 46°, the common spruce appears limited to an elevation of about five thousand nine hundred feet. In Lapland the birch is found at the altitude of one thousand six hundred feet in latitude 67° and 70°.

The influence of different altitudes on the distribution and growth of forest trees, is evident even in the inferior elevations of the forests of Britain. The pine, fir, and birch occupy the highest points*; next the sycamore and mountain elm; lastly, the oak, beech, poplar, ash, and chestnut. When the ground to be planted is, therefore, so high above the level of the sea, as to influence materially the nature of the climate, the forest trees to be planted should be selected according to the above principles. In practice this may be termed *region planting*. By imitating the natural process in this respect, not only the most profitable returns which the site and soil are capable of producing will be secured, but also the most ornamental effects produced on the landscape, and the useful ones of judicious shelter obtained. It generally happens in extensive planting that the soil varies in different parts of the site in its properties and fitness

* *The Mountain ash occupies some of the most exposed of the Dartmoor Fens.—Mr. Kingston.*

to rear one species of tree better than another. When these different soils are, therefore, planted with the different trees best adapted to each, masses of diversified outline will adorn the landscape, having all the effect of a tasteful design, and the trees will be individually of the most healthy growth, a point of the last importance in ornamental effect.

Experience proves that, for elevated situations, the Scotch fir, *Pinus sylvestris*, the Norway spruce, *Pinus abies*, the larch, *Pinus larix*, the hooked pine, *Pinus uncinatus*, the birch, *Betula alba*, the sycamore, *Acer pseudo-platanus*, and the mountain ash, *Pyrus aucuparia*, are the most profitable: these, with the silver fir, *Pinus picea*, black Italian poplar, *Populus nigra*, the alder, *Alnus glutinosa*, and the Bedford Willow, *Salix Russelliana*, according to the soil, are also the best adapted to plant as nurses for rearing the more valuable timber trees.

For low, damp, and boggy soils, the alder, ash, birch, abele-tree, and the willow, are the best.

To resist the effects of the sea-blasts, the sycamore, pinaster, yew, and laburnum have all been found superior to most kinds of trees. The live oak is a very tender tree, and will not exist in England. The habits of the live oak (*Quercus virens*) offer a prospect of this tree being serviceable for the above important purpose. It is a native of South Carolina, and there it is seldom found above twelve miles from the sea-coast. It thrives best when growing on isolated spots or little islands entirely surrounded by salt water. On the estate of Middleburg, situated on the Cooper river, twenty-four miles from Charlton, South Carolina, belonging to J. Lucas, Esq. of New Cross, Surrey, live oak trees averaging twenty-five feet in height, and nine inches in diameter, were selected from the woods by that gentleman and planted in the form of an avenue to his residence. The trees were taken up with as many of the fibrous roots as possible. The tops were lightened by partially reducing the size and number of the branches. Every tree succeeded well, and in the space of two or three years from the time of transplanting they were not to be distinguished from those in the neighbourhood which had grown unmolested. These facts shew that this tree is of hardy vivacious habits, and being also an evergreen, warrants a fair trial of its merits on the coasts of England.

Transplanting trees of large growth for immediate effect properly belongs to another division of the subject, ornamental planting. It may not be unnecessary, however, to state shortly the principles of the practice as lately brought forward by Sir H. Stewart, in his *Planters' Guide*. These are to take up the tree, with all its roots, fibres, and rootlets, and also the green or external system of branches and buds entire and unbroken, then to transplant these roots, rootlets, and external system of the tree in the same perfect state. The soil into which such trees are transplanted should be of a superior quality to that from whence they were taken, or at least that portion of it applied immediately to the rootlets should have an addition of very rotten manure. A point of great importance to success is the selection of the subjects. 1st. The tree should have a superior thickness and induration of the bark compared to that of trees which have grown up in a crowded state. 2d. Stoutness and superior girt of stem. 3d. Numerousness of roots, fibres, and rootlets. And, 4th, extent, balance, and closeness of branches. Where a tree, otherwise desirable, possesses not these protecting properties, it should be provided with them previous to transplanting by uncovering the roots partially, so as not to injure the stability of the tree during the process. To these exposed roots is applied a compost of fine earth, into which they shoot, and produce in two or three years numerous rootlets fit for transplanting. The overgrown branches are reduced so

as to balance the top on every side, if it require it. To assist the bark, such trees as intercept the air and solar rays are removed. These effects are also produced to the roots by cutting a trench at a proper distance from the stem round the roots, and filling up the trench with good soil; in two or three years, the roots will be increased in numerous ramifications as in the former mode.

Chapter IV.

Of the Soils and Sites most profitably employed in the Growth of Timber; intimate Nature of different Soils peculiarly adapted for the Growth of particular species of Forest Trees.

From what has been said respecting the advantages of judicious planting, the lands and sites most proper for the growth of timber will have been generally understood. There has been a difference of opinion whether land under woods or under tillage is the most profitable and beneficial to the proprietors and the public; the question is similar to that which exists respecting the comparative value of tillage land and permanent pasture, and may be solved in the same manner, viz., that the prosperity, if not the absolute existence, of the one is dependent on the other, and the interests of individuals as well as the public on both. The occupiers of land where woods are scarce, or wanting altogether, and those where they are in too great abundance, will coincide in the truth of this observation. The proportion which woods should bear to tillage and pasture lands in any one district of country depends on the nature of the soil, and the local demand for certain kinds of produce.

There can be but one opinion as to the advantages of planting exposed waste lands, and those that are steep, rocky, or precipitous. The loss to individuals and to the nation, by such large tracts of lands as those now alluded to lying utterly unproductive, is incalculable.

Lands of rather a superior quality to those, or which are accessible to the plough, and the barrenness of which is owing to exposure and ungenial climate, offer great inducements to forest-tree planting. For when the improvement is completed it is, to its extent, so much added to the territorial extent of the empire, in affording the means of sustenance as well as the enjoyment of human life*.

Lastly, where the local climate and soil are good, but where, at the

* From among the many instances to be found in Scotland of these effects produced by judicious planting in changing the face of nature from that of a desolate waste to comparative fertility and riches, may be particularly mentioned Blair Adam, the seat of the Lord Chief Commissioner Adam. Here land which, in its natural state, would scarcely afford any rent, has been so much improved by the skilful adaption of the different species of forest trees to the soil and site, the subsequent culture, and, above all, the judicious disposition or arrangement of the masses and narrower spaces of the plantations, as to render the shelter and amelioration of the local climate so genial as to produce corn and green crops as well as permanent pasture capable of rearing and fattening the improved breeds of stock (*a*). In England, barren moor soils have, in many instances of late years, been successfully planted. At East Court, in Berkshire, the seat of Charles Fyshe Palmer, Esq., M.P., a tract of extremely poor heath soil has been successfully planted by that gentleman. In a few years the aspect and climate of this before dreary, barren tract of land, will be completely changed. The plantations of Robert Denison, Esq., at Kilnwick Percy, Yorkshire, are arranged in the most judicious manner for shelter and improvement of the local climate. Mr. Hazlewood's larch plantations at Slaugham Park, in Sussex, are also arranged in the most effective manner for the improvement of the local climate. But there is scarcely a county in England where such barren soils existed, where examples may not be found of the beneficial effects of judicious planting.

(*a*) *Vide Appendix to the Agricultural Report of Kinrosshire.*

same time, a scarcity of timber exists for the periodical wants of agricultural and manufacturing operations, as for the various purposes of buildings, implements of husbandry, fencing, poles, machinery, fuel, &c., planting is of great importance and utility to the community*. In many cases, where the soil is of greater value, the planting may be confined to the angles of enclosures, and to hedge-rows.

In this last case it may be necessary to observe, that the land of the lowest comparative value for corn crops, and the most eligible for shelter and shade where required, should be chosen for planting.

When it happens that not all of these peculiarities of soil and site call imperiously for planting, it is proper to consider whether the value of timber or of coppice produce will not be greater from a given space of ground than that of corn or grass. The rent of the land will assist in determining the point, with the local demand for these crops. From numerous estimates of the returns from woodlands, compared to those of corn and pasture lands, under a variety of different circumstances, as to market for the produce, soils, and situations, 10*s.* per acre, per annum, of rent is considered the general maximum value of land, above which it ought not to be planted, but retained in corn or grass, and all land which rents under that value affords a very superior revenue under woods or plantations. There are undoubtedly many local circumstances which make exceptions to this rule; as where timber is scarce, or where the demand for certain kinds is unusually great, as in the neighbourhood of mines, hop-plantations, &c. There are instances on record of produce of the value of from 20*l.* to 60*l.* per acre, per annum, being afforded by woodlands; these, however, are extreme cases, and are here mentioned merely to show that exceptions may occur to the above mentioned rule; and that such returns are greater than can be expected from any other kind of crop whatever, particularly considering that the cost of culture, as repairs of fences, cutting down, and perhaps carting, is comparatively trifling to that of tillage and manuring, which every other crop of value besides wood requires.

It may be useful to take a more intimate view of the nature or composition of those varieties of soil which have now been alluded to. It is proper, however, to observe, that the following statements of the nature or constituents of these soils are not intended to convey the idea that they are the best sorts respectively for the different kinds of forest-trees, but principally to show that on such soils these trees have attained to great perfection of growth. The soils were selected from the spots where the trees mentioned in connexion with the soils were found by the writer of this treatise, and the trees were, on an average, the finest of the respective kinds which have come under his observation.

* The plantations made by the present Duke of Bedford are highly worthy of notice under this head of the subject, as being planned and executed in the most judicious manner. A statement of the number of trees and quantity of ground planted by John, Duke of Bedford, from the year 1802 to the present period, 1829; *viz.*

	Quantity of Ground. A. R. P.	Number of Trees.
Bedfordshire and Buckinghamshire	633 2 24	2,545,357
	Exclusive of 400 bushels of acorns and other seeds dibbled in.	
	A. R. P.	Trees.
Devonshire and Cornwall	819 0 0	2,859,754
Huntingdon and Northamptonshire	94 1 34	330,750
	Exclusive of 280 bushels of acorns dibbled in.	
	A. R. P.	Trees.
Total quantity of ground planted	1547 0 18	5,735,861
	Exclusive of 680 bushels of acorns, and other seeds dibbled in.	

The great importance of precision in the nomenclature of soils, whether in the details of planting or in husbandry, must be so clear and evident to every person who may be desirous to profit by the results of others' experience in these subjects, that it would be superfluous here to add more on the point.

1st.—Heath soil, or siliceous sandy moor soil, incumbent on shale or ferruginous stones, and frequently on siliceous sand of great depth.

400 parts consisted of fine siliceous sand	320
Carbonate of lime	2
Carbonate of magnesia	1
Decomposing vegetable matter, chiefly composed of the decaying leaves of heath	55
Silex, or impalpable earth of flints	11
Alumina, or pure matter of clay	3
Oxide of iron	4
Soluble matter, principally common salt, or muriate of soda	4
	400

The Scotch fir, *Pinus sylvestris*, the birch, and the beech, are found to succeed better on a soil of the above description than any other kind of tree. For the latter, however, it is necessary that the subsoil should be a deep sand. The larch and spruce, under the like circumstances as to subsoil, will also attain to good perfection on heath soil; but where the subsoil is rocky, or impervious to a free circulation of moisture by indurated sand, which is sometimes the case, these last-mentioned trees never succeed; the Scotch fir only maintains its growth.

2nd.—400 parts of poor sandy soil, incumbent on shale, or very coarse gravel.

Fine sand, principally siliceous	360
Impalpable earthy matter, 40 consisting of carbonate of lime	0
Decomposing vegetable matter, destructible by fire	4
Silex, or pure earth of flints	22
Alumina, or pure matter of clay	7
Oxide of iron	5
Soluble saline matters, chiefly muriate of soda	2
	400

The pine, larch, spruce, birch, and sycamore are the most proper for this kind of soil.

3rd.—Sandy loam, incumbent on siliceous sand, containing a large proportion of oxide of iron.—400 parts.

Fine sand, partly calcareous, and partly siliceous	200
Coarse sand	84
Carbonate of lime	6
Decomposing vegetable matter	15
Silex, or the earth of flints	56
Alumina	12
Oxide of iron	5
Soluble vegetable matter, containing sulphate of potash, vegetable extract, and common salt	4
Loss	24
	400

The larch, pine, and fir tribe in general will succeed well on a soil of this texture, although the beech comes to the greatest perfection, or is, perhaps, the plant most profitable to employ in planting soils of this nature, particularly when the subsoil happens to be deep sand, as is the case of the soil on which the celebrated beech trees grow in Woburn Abbey Park. A figure of one of the finest of these trees is given in Pontey's *Forest Pruner*.

4th.—Light sandy siliceous soil, incumbent on a damp clayey subsoil.

Siliceous sand, of various degrees of fineness	290
Gravel partly calcareous	40
Impalpable loamy matter, consisting of carbonate of lime	5
Silica, or earth of flints	38
Alumina or clay	9
Oxide of iron	5
Decomposing vegetable matter	8
Moisture and loss	5
	400

The oak grows rapidly on this soil, and should constitute the principal timber tree of the plantation. The sweet chestnut also attains to great maturity in the same kind of soil. The nurse trees most proper are the larch, spruce, and particularly the silver fir. The elm planted on this soil had not attained to the size of the above mentioned trees in the same period from planting, but the timber was considered of a superior quality.

5th.—Clayey loam, incumbent on a clay subsoil.

Coarse gravel, partly calcareous	40
Fine sand	190
Carbonate of lime	16
Decomposing vegetable fibre	14
Silex, or pure matter of flints	90
Alumina, or pure matter of clay	30
Oxide of iron	7
Soluble vegetable extract and saline matters, containing gypsum, common salt, and sulphate of potash	5
Loss and moisture	8
	400

This soil brings the oak to the highest state of perfection. The above results of analysis were afforded by an average sample of the soil of a part of Woburn Abbey Park, where some of the finest oaks probably in England may be seen, excepting those of Lord Bagot at Blythfield Park. The following nine trees grow near together on the soil above described, and are therefore here selected to show the powers of a soil so constituted in the production of oak timber.

Oak No. 1.—The bole or stem measures, in timber, upwards of 50 feet in height, and the limbs extend from the stem 40 feet.

		Ft.	In.	
	At 3½ feet from the ground	17	3	circumference.
	At 10 ditto ditto	14	6	
	At 20 ditto ditto	14	0	
Oak No. 2.—At	4 ditto ditto	17	9	
	At 7 ditto ditto	15	6	
	At 13 ditto ditto	13	6	
	At 20 ditto ditto	12	9	

			Ft.	In.
Oak No. 2.—At 35 feet	from the	ground	11	4
Oak No. 3.—At 4	ditto	ditto	13	0¼
At 10	ditto	ditto	13	0
At 20	ditto	ditto	12	0½
Oak No. 4.—At 3	ditto	ditto	12	0½
At 18	ditto	ditto	10	0
At 66	ditto	ditto	8	0¼
Oak No. 5.—At 4	ditto	ditto	14	0
At 20	ditto	ditto	12	0½
At 56	ditto	ditto	9	0½
Oak No. 6.—At 3	ditto	ditto	14	4
At 34	ditto	ditto	12	6
The limbs extend from 40 to 46 feet from the bole.				
Oak No. 7.—At 4	ditto	ditto	12	0
At 50	ditto	ditto	8	0¼
Oak No. 8.—At 4	ditto	ditto	13	0½
At 12	ditto	ditto	11	0¾
At 50	ditto	ditto	8	0½
Oak No. 9.—At 3	ditto	ditto	13	0¼
At 20	ditto	ditto	12	0
At 48	ditto	ditto	8	0¾

The lowest estimate of timber in these nine trees is 3,200 cubic feet of the very best quality for naval architecture. It is remarkable, that though they must be of a great age, no symptoms of decay appear in the growth of these trees; they are perfectly sound and free from blemish*.

6th.—Damp clayey soil incumbent on clay.

Coarse siliceous gravel	60
Fine sand	120
Vegetable matter, destructible by fire	9
Carbonate of lime	15
Silica, or earth of flints	130
Alumina, or pure clay	48
Oxide of iron	10
Soluble saline matter, with vegetable extract, and gypsum	8
	400

The oak, elm, ash, and hornbeam attain to greater perfection here than any other kind of forest-tree. The tulip tree (*Liriodendron tulipifera*) grows freely on this soil when it is properly prepared by trenching. The Norway spruce, pinaster, and Weymouth pine appear to be the only species of the resinous tribe of trees that make tolerable growth on a soil of the nature above described.

* Lord Cowper's Pensanger Park oak, near Hertford, grows in a clay and sand soil or sandy loam.

	Cubic measure.
In 1814, the stem of this tree measured 64 feet high	629 feet.
One limb, 54 feet long	67
	696
Other limbs measured	290
	986

This tree was again measured in 1826, and had increased to 1100 feet cubic measure. The first length of the tree, up to the first branch, is 17 feet, and 19 feet 6 inches in circumference, measuring in cubic contents about 400 feet.

7th.—Fertile peat moss, incumbent on clay or marl.

Fine siliceous sand	281
Undecompounded vegetable fibre	13
Decomposing vegetable fibre	57
Silica, or impalpable earth of flints	50
Alumina, or pure matter of clay	18
Soluble matter, principally vegetable extract	4
Oxide of iron	2
Moisture and loss	25
	400

This variety of peat soil when prepared for planting by draining off the superfluous moisture, with which it is found almost always saturated, is capable of growing very profitable trees, as the birch, abele, poplar, willow, and even the Scotch fir. A piece of ground of this nature, prepared by cutting open drains at such distances from each other, as to leave a sufficient breadth or body of earth to retain a due proportion of moisture in dry weather, and yet prevent saturation of moisture in the wettest weather, was planted with a variety of trees. The trees above mentioned succeeded remarkably well, and made an improved return of a hundred per cent. in comparison to that afforded by the natural produce of the surface. The following variety of peat, which is not uncommon, is to be carefully distinguished from the above:—

8th.—Inert* peat soil.

Fine pure siliceous sand	29
Inert vegetable matter destructible by fire	289
Alumina	14
Oxide of iron	30
Soluble vegetable extractive matter, sulphate of iron, and sulphate of potash	11
Sulphate of lime	12
Loss and moisture	15
	400

The outward characters or appearance of this soil is so similar to those of the first-mentioned variety of peat, that they are scarcely to be distinguished by common observation. The above soil, in its natural state, is absolutely sterile. Large applications of caustic lime and of common salt, in a smaller proportion, had the effect of improving the nature of this soil so much, as to render it capable of vegetating turnip seed, and of bringing the roots to the size of small turnips. It has not been proved, however, what the results of planting forest-trees might be on this soil, improved in the manner now stated.

9th.—Chalky soil, incumbent on chalk-rock.

Calcareous sand	280
Carbonate of lime	60
Decomposing vegetable fibre	5
Silica	28
Alumina	10
Oxide of iron	8
Vegetable and saline soluble matters	4
Moisture and loss	5
	400

* The inert or sterile property of this peat appears to arise chiefly from the excess of sulphate of iron and sulphate of potash and lime which it contains. When burnt, the ashes are found to be a valuable manure for chalky soils.

The beech, ash, and oak thrive better on a soil of the above composition, than any of the resinous or fir species of trees.

10th.—Rich alluvial or marsh soil, on the estate of Lord Saye and Sele at Belvidere, near Erith, in Kent, situated partly below and partly above the level of the river Thames.

	Grains
Fine sand	98
Aluminous grit or stones	68
Carbonate of lime	15
Decomposing animal and vegetable matter	40
Silica or impalpable earth of flints	115
Alumina or pure matter of clay	32
Oxide of iron	12
Sulphate of lime or gypsum	3
Soluble vegetable extract and saline matters, giving indication of not more, or rather less, than the usual quantity found in soils generally of the muriate of soda or common salt	6
Moisture and loss	11
	400

This soil had the character in the neighbourhood of being incapable of growing any kind of tree: it was supposed to contain an excess of common salt. The Hon. Twisleton Fiennes has put this interesting question to the test of trial. We examined this soil chemically as above, and found that common salt entered but little into its composition. The stagnant moisture with which it was surcharged appeared to be the chief, if not the only defect of the soil. The subsoil in part is peaty and incumbent on a clayey marl. A large open drain was made so as to command the water in the space set apart to be planted. The ground was properly trenched and thrown up into broad ridges, as recommended at p. 22 of this Treatise, with secondary drains between each ridge, communicating with the principal one. The ground was planted with a numerous variety of trees for the purpose of experiment. The results now obtained show that the poplar (*Populus nigra*), willow (*Salix alba et Russelliana*), elm (*Ulmus montana*), sycamore (*Acer pseudo-platanus*), ash (*Fraxinus excelsior*), alder (*Alnus glutiosa*), locust (*Robinia pseudo-acacia*), birch (*Betula*), oak (*Quercus robur*), horse-chestnut (*Æsculus hippocastanum*), Spanish chestnut (*Castanea vesca*), hornbeam (*Carpinus betulus*), lime (*Tilia eur pœa*), spruce fir (*Pinus abies*), with dog-wood (*Cornus coccinea*), privet (*Ligustrum vulgare*), holly (*Ilex aquifolium*), and hazel (*Corylus avellara*), as underwood;—these different species of trees have succeeded in the order nearly as they have been enumerated, the first eight-mentioned sorts having, up to this period, a decided advantage over the others. The Hon. Mr. Fiennes purposes to continue and extend this interesting investigation; the results of which will decide the question, which is one of importance to the owners of soils of this nature.

Of the above varieties of soils, if we except the sandy loam No. 3, and the clayey loam No. 5, there is not one which, on its natural site, could be profitably cultivated under corn or green crops, but which, by skilful planting, might be made to return considerable profits to the owners, and also to the public the many advantages which judicious planting always confers.

Although there may be found shades of difference in the proportions of the constituents of soils receiving the same designation, such, for instance, as the poor sandy soil, containing ten per cent. more or less of sand in one situation more than another, yet the actual produce of timber,

all other circumstances being equal, will be found to vary but little, if any. But where the difference in the proportions of the ingredients is found so great as exists between the sandy loam No. 3, and the poor sandy soil No. 2, or, in a wood as between any two of the soils now attempted to be described from practical experience in their culture, as well as from a careful chemical examination of their properties and constitution, a very marked and decisive difference will be found in the comparative produce of timber, and in the peculiar species or kinds of trees which should have been planted in the greatest number, or in preference to others.

Chapter V.

Of the most approved Modes of preparing different Soils for the reception of the Plants—Fencing, Draining, Ploughing, Trenching. Of the formation of Rides or Carriage-Ways into the interior of Plantations. Of the best Mode of covering these with Herbage.

In no improvement of landed property is economy in the first outlay of capital more essentially required than in forest planting. Want of attention to this important point has caused much loss to the country as well as to individuals, it having had the effect of discouraging forest planting generally, and more particularly of those lands emphatically termed wastes. The evil is perpetuated by statements confounding the expenses of planting different descriptions of land, such as that of a superior soil immediately connected perhaps with a mansion, and that of a distant hill or waste heath. In the former case the return of produce is early, great, and fully ample for every expense judiciously incurred in the plantation; while, at the same time, something must be allowed for obtaining the more immediate ornamental effect of wood. In the latter case the returns of profit are more distant, though equally certain, and the outlay of capital or expense of formation proportionally less. To estimate or make them equal to those of the first description of land, would be absurd, because unnecessary, and, in fact, impracticable, as in the case of rocky sites or thin heath soils, where the more expensive processes of the preparations of soils cannot be carried into effect. To say, therefore, that land cannot be profitably planted under a first outlay of ten pounds sterling an acre, or that the expense of planting should not exceed two, or at most three, is equally erroneous; although both statements, individually with reference to local circumstances, may be perfectly true and accurate.

Fencing is one of the most expensive but essential concomitants of planting; for unless young trees are completely protected by proper fences, extensive failure will be the certain consequence.

In general the materials fit for constructing plantation fences may be found on the spot. On sandy heath soils, the turf interwoven with the roots of heath or coarse herbage affords a ready and cheap material. We have seen a wall or *dyke*, built entirely of turf, last for a great number of years without wanting any repairs whatever. The turfs were cut to the depth of from three to five inches; according to the depth they were pervaded with the tough roots of grasses and heath, which tend to keep them firm and less assailable by the weather. This wall of turf was two feet wide at the foundation, and four feet and a half high, terminating at sixteen inches in thickness at the top. The turfs were built in rows alternately edgeways, and flat with the turf side downwards. The coping consisted of a row of turfs laid with the grass side upwards, and this continued permanent for many years. When the soil is clayey, or of a texture liable to

crumble by the effects of the weather, banks are thrown up four feet wide at bottom, four feet and a half high, and eighteen inches wide at the top. On the top a double row of furze should be sown, and the face of the bank defended from cattle by driving in stakes of forked larch or thorns, from two to two feet and a half in length. These stakes may be fixed in the bank about a fourth of the whole height of the bank from the furze, and pointing obliquely upwards. Where these stakes could be conveniently procured about the thickness of an inch and a half or upwards, we have found them to answer the purposes of a protection to the furze remarkably well: these are the cheapest modes of fencing a plantation. Where stones fit for building a dry stone wall prevail on the site, they may be used with great advantage for constructing the fence. In building a dry stone wall, i. e., without mortar or cement of any kind, it is of importance that occasional courses of stones of a size to reach across the thickness of the wall should be laid in; these act as ties, and render the wall strong and lasting. The coping is another point of importance to be attended to: the best coping is that composed of flat stones placed edgeways, and made compact and immovable by driving in wedges of stone at such distances from each other in the coping as will produce the desired effect, and a very little experience or practice will teach the workman to place these wedges in their proper points. The expense of constructing this kind of fence varies according to local circumstances. The cost of fences of this description is stated by Sir John Sinclair in his highly valuable work, the *Code of Agriculture*, to vary from 4*s.* 6*d.* to 6*s.* the perch, which agrees with the results of our inquiries and experience on the subject.

When neither of the above simple fences can be conveniently adopted, a *quick* or thorn hedge is the most generally used, and in fact is the best and cheapest. There are several kinds of *quick* fences, which differ merely in the mode of planting the thorns (*Cratægus oxycanthus*). The white thorn is a plant much checked in growth by every other, whether herbaceous weed or shub, that mingles with it in the soil. It delights in a strong loam, on poor sands, or damp clay; its growth is much slower, and requires great attention in the preparation of the soil, in the selection of the plants, and in the mode of planting. It must be carefully protected from cattle and rabbits, which, by nipping off the tender first shoots of the spring, seriously injure its growth, and defeat the intention of raising an effective fence at the least cost, and in the shortest space of time.

On poor sandy soils, the depth of earth for the reception of the plants should be made as great as possible, and they should be placed on the top of the bank*. Manure of rotten leaves, compost of marl or clay, and dung, ashes, or any substance that will enrich the line of planting, should be dug in if possible for the encouragement of the roots of the young quick. Where the soil is damp and clayey, planting the thorns on the face of the bank is the best practice. The ground should be perfectly clean, or the cost of weeding it afterwards will be considerable, and the fence will make little progress, if it do not fail altogether.

The cost of the manure above alluded to will be amply repaid by the more rapid growth of the quick, saving much of the expense of weeding, and of filling up blanks and gaps in the hedge, which always accompanies the rearing of this kind of fence on poor or badly prepared ungenial land. The size of the plants deserves particular attention, for by planting strong three year old transplanted thorns, the success of the fence is secured, and the distance of time for its completion shortened by three years. To

* *The Salix cinerea and one or two hindred species make useful and hardy fences if cut in the form of stakes, and driven in on the top lattice-form, seldom fail to strike root, and in the mean time form an effectual barrier.—Mr. Kingston.*

protect the thorns from cattle, a ditch with post and rails are adopted. (*Fig.* 8. *a*). When rabbits abound in the neighbourhood of a young quick fence, they are often very destructive to the plants. The means of preventing these animals from having access to the young thorns is too expensive to be adopted for forest fences*. A row of thickly planted dead hedge on each side of the row of quick, is, perhaps, the best temporary protection; but the most effectual mode is to keep down the number of the rabbits, or, if possible, to take them away altogether.

When stones can conveniently be had, the facing of the bank with these, and planting the quick so as to spring through the wall, (*fig.* 8. *b*,) forms the most secure and lasting fence. The expense of weeding is saved by it; and, under such circumstances, the plants generally make great progress.

In the management of the hedges when planted, weeding is most essential, for if coarse grass or rampant weeds are suffered to mingle with the lower branches and foliage of the quick, the injury is very considerable. The top of the hedge should be kept level from the first cutting, until the plants have attained to the desired height. The sides of the hedge ought to be kept also of an even surface; by shortening the side branches every year to within an inch more or less of the preceding year's wood, the bottom of the hedge is maintained equally thick and impenetrable with the upper portion. The most generally approved form of a hedge, is that of the hog's mane; however, if the soil has been properly prepared, the plants selected of the largest size, and the keeping clear of weeds, and most judicious mode of pruning persevered in, the hedge will flourish in every shape.

Fig. 8.

By keeping the top of a hedge level, it is not meant that all the plants should be shortened in the leading shoot of the stem, but only those which overtop their thin neighbours. If this be properly attended to, the evil effects which follow the practice of shortening without exception the leading shoots of every plant of the hedge will be avoided, as well as those which occur when the upright growth of any plant is left uncontrolled until it reach to the desired height.

Where a hedge has been neglected, is overgrown and irregular, the best mode is to cut it down level with the soil, and then to dig the earth about the stumps, inserting plants of strong quick in the gaps where they occur. It may happen that the fence cannot be dispensed with, for the time the young shoots from the old roots require to renew the fence. In this case, the mode of cutting a fourth part of the stems to the desired height, and another fourth part a few inches from the ground, and warping the remainder with these, is found a useful practice.

Besides the white thorn or quick, and the furze (*Ulex europæus*), there are many other shrubs which may be planted under certain circumstances with effect as fences. In exposed cold soils, the Huntingdon willow, beech, birch, and alder, may be used with advantage.

It may be unnecessary to mention, that where larch poles can be had, they afford an excellent material for fencing, particularly when used with

* For protection to gardens against the depredations of rabbits, or turnip crops exposed in the fields, &c., a wire netting has been invented, which completely answers the purpose. The expense for these purposes is so moderate, as to render the adoption of the wire netting no matter of difficulty. We witnessed the effects of the practice at Cantley Hall, the seat f John W. Childers, Esq.

the bark, which tends to preserve the wood from the effects of moisture and air*.

Draining is essential wherever stagnant moisture prevails in the soil. Boggy lands and tenaceous clays are chiefly the soils which require it, for trees will thrive in a degree of moisture that would be highly hurtful to the nutritive grasses, and to corn crops. Under drains are of little service for forest-trees, as their roots soon render these ineffective. In general, therefore, open cuts should be used. Where the excess of dampness is caused by springs, as in most bogs and morasses, it is essential to ascertain the source of the principal springs which feed the secondary ones, and their numerous outlets over the surface. Sub-aquatic plants, as the alder, rushes, &c., often point out the spots where the search should be made, although these plants are frequently supported by stagnant surface water. Boring with the auger is the best mode of ascertaining the source of the spring, or at least that level of its course in the strata which conducts the water to the boggy land, and where it can be effectually cut off from supplying the secondary springs and outlets in the lower levels. When the source is ascertained, a drain should be cut to the depth of the strata through which it passes, so as to obstruct its progress. It should be made sufficiently deep, or the water will continue to pass under it, and the work will be useless. From this main drain formed across the declivity, other secondary drains should be made to conduct the water thus collected, from the source to the most convenient outlet. It would be incompatible with the space of these pages to enter into details of this subject. Elkington's mode of draining, as given in Johnstone's Treatise on the subject, is on the above principle, and shews with precision the advantages of it, and with how much facility lands, which by the old method of draining were considered incapable of being profitably improved, may be made fit for planting and returning a valuable produce of timber.

Clayey soils which are rendered barren by surface water stagnating upon them, may be made to produce valuable timber by the simple process of constructing open drains, and forming the surface between these into ridges, as before mentioned in Chapter III.

On steep acclivities, rocky soils, and thin heath, or moor lands, incumbent on rock or shale, where ploughing or trenching is impracticable, a depth of pulverized soil cannot be obtained for the reception of the roots of trees of more than two, or at most three years' growth; the mattock planter, diamond dibble, and spade, can be used with the best effect. To attempt any more expensive preparation on such lands, than may be made by these implements for the reception of the individual plants, would be injudicious. The number of valuable woods which have been reared in this way, are too generally known to need particular mention here. The cost may be stated to be from two to five pounds per acre. For the preparation of heath soils, incumbent on sand or loose gravel, an improved paring plough (*fig.* 9 and 10), which we call Fyshe Palmer's planting plough†, is a valuable implement.

The plough consists of two mold boards as in common use, but resting on a triangular and somewhat convex plate of iron (*fig.* 9). This iron

* It is the opinion of some practical persons, that the bark being left on larch poles, encourages or attracts insects to nestle under it, and thereby hastens the decay of the wood, unless it happen that the trees are cut down in winter, or when the sap is down.—*Mr. Lance.*

† Charles Fyshe Palmer, Esq. M.P., in planting a large tract of waste land on his estate of East Court in Berkshire, after various trials, found this plough which he invented a most effective implement in paring off the heath-turf. It economises time as well as expense.

plate is furnished with sharp steel edges riveted to it (*fig.* 10, *c*). The fixed share (*a*, *fig.* 10), which divides the turf for each side of the double moldboard, is six inches high at the shoulder, with a sharp edge tapering to a point at (*b*). The sole of the plough is screwed and bolted to the instrument by the bolt sockets (*e*), and the nut screw sockets (*d*). The base of the triangular plate *f* (*fig.* 9) is twenty-one inches, with a curve of one inch, which facilitates the action of the instrument when paring in gravelly or stony ground. The whole length of the plate is thirty-five inches from the base (*f*) to the point of the share (*b*). Wherever the land is of a moderately level surface, and when paring is desirable, this plough will be found a valuable implement. The whole surface may be pared as in clayey soils, where burning the turf is essential; or spaces of twenty-one inches, as in heath soils, may be pared off with intervals of thirteen inches, on which the reversed turf may rest to decay, and become food for the roots of the trees. When the soil is of sufficient depth to allow of trenching, the common plough, following the track of the paring plough, will effect this object at a comparatively small expense.

Fig. 9.

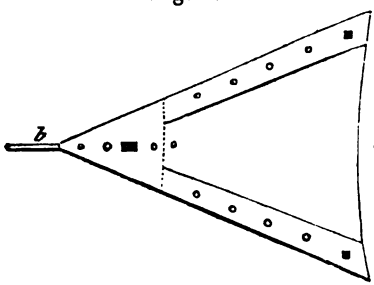
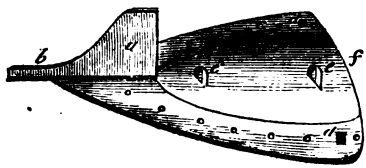


Fig. 10.



Much difference of opinion prevails on the comparative advantages and disadvantages of trenching ground for forest trees; nothing is more certain than that trenching and manuring is more advantageous to the trees than holing, or any other mode of preparation. But there are certain soils which will produce valuable timber, and that cannot be ploughed or trenched; these have already been mentioned: there are others which are capable of receiving benefit from this mode of preparation, but where it would be inexpedient to bestow it. There is one instance in which trenching cannot on any account be dispensed with, which is that of ground near a mansion, where the value of trees in respect to landscape effect, shelter, shade, concealment, and the improvement of local climate, have equal if not superior claims to that of the actual value of the timber produced by the individual trees of the plantation. The question as regards other sites and soils, intermediate between these two now mentioned, and of a nature as regards texture and quality similar to the soils described in Chapter IV., under the numbers 3, 4, 5 and 6, which are capable of rearing mixed plantation, or a variety of different species of forest trees in perfection, the process of trenching or ploughing, and also manuring when possible, ought to be adopted. In this instance, however, it is highly necessary, before adopting the more expensive preparation, to ascertain exactly the cost of each mode of planting, and the probable return of profit from the outlay. As many local circumstances interfere with the performance of these different processes, as the comparative cheapness of labour, of manure, the facility of obtaining the most proper sized plants, to anticipate two or three years' earlier return of produce, &c., it would be of little use here to give any calculations of expense and profits, as data by which to estimate the results of either mode of practice, that would be applicable

to every soil and site alluded to. Where the local demand for the smaller sized products of plantations are great, the more expensive process of trenching should be adopted, inasmuch as the growth of forest-trees to the size of poles, and of materials for fencing, &c., is highly promoted by trenching and manuring, and the returns of profits from these products of planting are in proportion earlier and larger. That this superiority extends in the same proportion to the ultimate produce of timber in trees, may not appear so clear, because it may be urged by those who undervalue trenching and manuring as preparation of the soil for planting forest-trees, that there are no satisfactory records of the comparative rate of increase of timber, or of solid vegetable fibre, after the first twenty or thirty years' growth of the different species of forest-trees, which have been planted on trenched and manured grounds, and the contrary, being under all other circumstances the same until their last stage of perfection; and yet the truth of such continued superiority of increase, is the only test by which the question can be decided, and an unerring rule of practice be obtained. The results of mere observation, or conclusions drawn from the apparent contents of trees, will not be found to warrant the adoption of any new mode of practice. But the comparative increase and ultimate produce of timber should be ascertained up to the period of the trees attaining to perfect maturity in the most satisfactory manner, by actual admeasurement; and correct records kept of the age of the trees, comparative value of the plants when planted as to their size, roots, and constitutional vigour at the time of planting; as also the intimate nature of the soil, subsoil, and local climate. In the oak, after the first fifty or sixty years' growth, the annual rate of increase of the diameter diminishes greatly. The Lambert pine-tree (*Pinus Lambertiana*), mentioned in the *Trans. Linn. Society*, vol. xv. p. 497, exhibited an increase of diameter of four inches and a half only at the base, during the last fifty-six years of its growth.

These last remarks apply to the question generally; but in all cases of exception before mentioned, and in the instances of clayey, tenacious soils, and compact gravelly loams, trenching ought doubtless to be adopted as a preparation for the reception of forest-trees*.

* The advantages of trenching have been zealously and ably advocated in a late publication by Mr. Withers, to which we have already referred, and the proofs brought forward in support of his arguments are satisfactory as far as they go; but the most important facts are those of the superior increase, and the comparative quality of the timber when the trees have attained to full maturity. Registers of the facts stated by Mr. Withers, continued until the trees attain to full timber size, and of the buildings or purposes to which, in certain cases, the timber is applied, are what would afford invaluable information, and for which posterity would be grateful. A distinguished writer asserts that after the first twelve or twenty years of growth of trees planted on land prepared by trenching, all distinction is lost between the *apparent* growth of these and of those which may have been planted by the simple process of holing. In general cases, the observations of the writer of this have led to precisely the same conclusions. It is improbable, however, that the superior growth which so distinctly marked the progress of the plants on the trenched ground during the first years of growth should wholly cease, but that it diminishes in proportion as the soil, which had been loosened by the process, becomes consolidated to its original state, and in proportion as the roots advance in the subsoil which had remained equally undisturbed in the execution of both modes of preparation, is quite certain. Whether this superior rate of produce, though reduced in degree, continues until the tree attains to perfect maturity, or ceases before that period, we have certainly no records of facts to shew. Farther, as regards the progressive increase of wood in trees, different species vary in this particular. The locust, for instance, will make shoots of six feet in length for a few of the first years of its growth, or, if cut down when in a healthy state, will produce in one season shoots of three yards or more in length; but to conclude from this circumstance that the locust is one of the fastest growing trees, or even that it is equal in this respect to the slow growing oak, would be erroneous, inasmuch as, at its fifteenth

In order to have at all times the most convenient as well as the most pleasant access to the interior of the plantation, rides or broad drives should be marked out and left unplanted. On heaths and gravelly soils the surface is in general so level and unbroken as to require the lines or edges of the rides merely to be cut out in the form of a shallow water-course, any inequalities of the surface to be made good with the turf or earth taken out. In damp, clayey soils, the rides should be made higher in the middle and sloping on each side to an open drain, marking the line of each side*. The earth should be made fine and sown with the following grass seeds, *viz.*, *Alopecurus pratensis, Dactylis glomerata, Lolium perenne, Cynosurus cristatus, Phleum pratense, Anthoxanthum odoratum, Poa trivialis, Festuca pratensis*, with red and white clovers combined, at the rate of four bushels and a half to an acre. For dry, sandy, heath soils, which can scarcely be covered with verdure, the following will be found effectual:—*Festuca*

year of growth, the annual rate of increase in height is found to be reduced to inches instead of yards or feet, and at the age of thirty or forty years it may be said to cease altogether to advance in stature; while the oak, which has before this period overtopped the locust, continues its comparatively steady annual increase for a century. And, with certain modifications of the rate of annual increase between the first and subsequent stages of growth to perfection, the same principles will apply to the willow (*a*), poplar, alder, birch and the pine tribe, on the one hand, and to the oak, chestnut, elm, beech, ash, &c., on the other.

(*a*) The Bedford willow (Salix Russelliana) when planted on a damp, clayey loam, on a rising site, has been observed by the writer of this to attain to the height of thirty feet in five years, but after that the annual rate of increase diminished to inches, and then the tree became in appearance stationary. The celebrated willow in Staffordshire, known under the name of Doctor Johnson's Willow, is of this species. Since the above was sent to the press we have had the gratification of perusing the *Salictum Woburnense*, or a catalogue of the willows indigenous and foreign in the collection of the Duke of Bedford, at Woburn Abbey. This contains the fullest account of all the different species of this interesting tribe of plants that has yet appeared. As regards the willow above alluded to, it is observed in the introduction to the work by the noble author, that 'the Rev. Mr. Dickenson assured Sir James Smith and myself that the great willow at Lichfield (commonly called Johnson's willow, from a belief that it had been planted by him) was of this species. Dr. Johnson never failed to visit this willow when he went to Lichfield.' In 1781 it was reported to be nearly eighty years old, and Mr. Dickenson says, 'the venerable sage delighted to recline under its shade.' The noble author further observes, 'I can state another instance from my own personal knowledge of this species of willow attaining a great size within the ordinary period of a man's life. A willow-tree on the south lawn at Gordon Castle, in Scotland, was planted by the late Duke of Gordon about 1765; it was then in a small box four feet square, floating on the surface of the lake, and shortly sank on the spot, where it took root. The lake has long since disappeared, and the tree was blown down in a storm on the 24th November, 1826, the tree being then sixty-one years old. I examined this tree a few years ago, and found it to be the *Salix Russelliana* of Sir J. E. Smith.'—*Salictum Woburnense*, Introduction, vi.

* At Blair Adam, in many instances, the plantations were originally made with broad rides; in others where that was omitted in the original planting, it has been accomplished by cutting out the trees. These, while the plantations were young, served the double purpose of access, for the convenience of carrying out the thinnings and for pleasure, because then it was possible to proportion the loading of the carriage, by putting a greater or smaller number of trees, according to the state of the rides in point of moisture or distance; but now that one tree makes a load, and that its weight cannot be diminished, the injury done to the ridings was so great as to impede both the convenience and the pleasure of the rides, and great expense was incurred in putting them in repair. To avoid this, what are called wood or thinning lanes have been adopted, by cutting out trees in proper lines for them; this shortens distances to the place of deposit (for rides are always circuitous) and is of benefit to the woods by admitting air more generally, care being taken that they are so twisted as not to incur the risk of being blown down. It is proposed (as they are easily got) to fill the rutts with broken stones. Where stones are not easily to be got, the rutts might be filled with trees not otherwise useful, so as to make a sort of coarse railway. This plan will, in the end, save a great deal of expense and labour, and secures at all times the proprietor's access to the woods and his seeing what is going on.

ovina, Festuca duriuscula, Aira cæspitosa, Aira flexuosa, Cynosurus cristatus, Agrostis stolonifera and *vulgaris, Achillea millefolium, Trifolium minus*, and white clover. Game are fond of these grasses.

Chapter VI.

Of the Culture of Plantations; Soil; Pruning; Thinning; remedies for accidental injuries and Natural Diseases of Forest Trees. Of the Tanning afforded by the Bark of different Species of Trees.

The judicious culture of plantations is a point of the last importance to secure a full return of profits from the capital expended in their formation, as well as for every other advantage that judicious planting confers; for let the care and skill employed in their formation have been ever so great, if the proper culture be not continued from the period of planting to maturity of growth, disappointment in obtaining the effects of wood, and loss of profits will be the certain results. The numerous instances to be seen almost everywhere of the bad effects resulting from the neglect of judicious pruning and thinning of the trees of plantations, and the great loss caused thereby to the proprietors, evince fully the importance of this branch of the subject, which embraces the following points:—

1st. Culture of the soil.
2d. Pruning.
3d. Thinning.
4th. Remedies for accidental injuries, or natural diseases.

First. The culture of a trenched soil of a newly-formed plantation, consists in keeping the surface clean of weeds until the shade of the trees prevents their growth. It is true that these weeds take a portion of nourishment from the soil, but from what was before stated regarding the food supplied to the plants by the soil, it is clear that the growth of herbaceous weeds can injure but little, if in any degree, the growth of forest-trees. When the trees are young and of a small size, however, the mechanical effects of these weeds are extremely hurtful when they are suffered to grow and mingle their shoots with the lower branches of the young trees, by obstructing the free circulation of air, and preventing the genial influence of the solar rays from reaching to their tender shoots, and this is evident to common observation in the decay or death of the branches subjected to contact with them, and in the consequent unhealthy appearance of the leading shoot of the tree.

Hoeing the surface as often as may be required to prevent perennial weeds from forming perfect leaves and new roots, and annual weeds from perfecting seeds, is all that is required. Two seasons of strict adherence to this rule, even in the worst cases, will render the labour or expense of future years comparatively trifling, and the healthy progress of the trees will reward the care and attention.

On soils planted by the slit, or holing-in mode of planting, it is essentially necessary to prevent the natural herbage of the soil from mingling with the lateral branches of the young tree. An active workman with a steel mattock-hoe will clean round the plants on a large space of ground in a day. Summer is the best season for the work, as the weeds are more effectually destroyed, and the partial stirring of the soil about the roots of such plants as require cleaning benefits their growth.

Should the planting and culture now described have been faithfully

executed, there will be few failures. When these happen, however, the vacancies must be filled up, at the proper season, with stout plants, and the holes be properly prepared for the reception of the roots. It is a good practice for the first two or three years of a trenched plantation to take a crop of potatoes, mangel wurzel, or carrots, according to circumstances. The rule, which must be strictly adhered to in the introduction of these crops, is, that no part of the foliage or tops of the green crop touch or even approximate near to the young trees; a rule of practice which, if broken through, produces equal damage as from a rampant crop of weeds to the plantation.

Second. There are three different kinds or modes of pruning, which, in practice, have been named close pruning (*a*, *fig.* 11). Snag pruning (*b*), and foreshortening (*c*).

Fig. 11.

By leaving a snag (*b*) of the branch, it in time forms a blemish in the timber, in consequence of young wood forming round the stump, and embedding it in the tree. Snag pruning is the most rude and injudicious mode that can be practised, being invariably attended with injury to the quality of the timber: it should never be adopted under any circumstances whatever. Close pruning (*a*) is performed by sawing or cutting off a branch close to its parent stem or primary leading branch (*c*). This is the only mode to be adopted in training, or rather improving, the stem or bole of a tree, or wherever it is desirable that no reproduction of branches from the point should follow. The most perfect manner of executing the work is to saw the branch off close to the parent stem, and smooth any roughness that may be left on the surface of the wound with a sharp knife, taking care not to reduce the edges of the bark which surround the wound more than is actually necessary to remove the lacerated surface. To prevent the action of air and moisture on the naked wood, a dressing should be applied, composed of ingredients that will adhere to the spot, and resist the action of drought and rain. Three parts of cow-dung and one of sifted lime will be found a very effective substitute for the more compound dressing of Forsyth. The dressing should be laid on one-quarter of an inch in thickness, or more when the wound is large: when rendered smooth and firmly pressed to the part, powdered lime should be thrown over the surface, and pressed into it by the flat side of the pruning knife, or a spatula. The bark will sooner cover the wound when protected from the influence of the weather by this or by any similar means, than when left naked and exposed*.

In general forest pruning this process is unnecessary, or rather the benefit is not sufficiently great to warrant its cost; but for particular trees connected with ornamental effects it is well worth the trouble.

Fore-shortening pruning (*c*) is the only one that can be usefully practised

* The fate of Mr. Forsyth's discovery of a composition applied to heal the wounds of trees, and to renovate decaying vital functions of vegetable growth, is similar to that of all other discoveries where the principles of such are pushed too far. Hence, one party ridicules it as good for nothing, and another pronounces it as infallible; while the truth lies between. In a long practice the writer of this has always used it with beneficial effects in every case where it was more than usually desired to have the bark speedily closed over a wound in a tree, but for the ordinary cases of forest-tree pruning it has never been used, and for the reasons before stated.

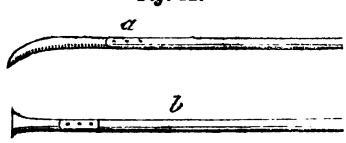
in reducing the size of lateral branches. When these become too crowded, or when particular ones assume a disproportionate vigour of growth and increase, it is highly useful to reduce the number or size of such over-luxuriant branches. The chief point to be attended to in the operation is that of dividing the branch at a point from whence a healthy secondary branchlet springs, that it may become the leader to that branch. When the shoot is of one year's growth only, and has no lateral shoots, as in stone-fruits trained on walls, the division is made near to a strong healthy bud, which will become the conducting shoot.

For young forest-trees which require the branches to be regulated and balanced, so that one side may not have a disproportionate number or weight of branches to the other, and for trees in hedge-rows whose lateral branches extend too far on either side, injuring the quick fence or the crops of the field, fore-shortening is the most useful mode of pruning.

For non-reproductive trees, such as all the different species of the pine or fir tribe of forest-trees, this mode of pruning is improper, as the branch thus shortened does not produce a second shoot, but remains with all the objectionable properties of a *snag*, to the great injury, in time, of the quality of the timber. Where the purposes of evergreen masks, near the ground, in the margins of plantations are desirable, the foreshortening of the leading shoots of spruce firs, &c., is highly useful, as these trees do not afterwards increase in height, but only extend laterally by thin side branches.

The most effectual pruning instruments are a strong knife, hook, saw, and chisel. For pruning elevated branches a small saw firmly fixed to a long handle is highly useful (*fig.* 12, *a*); a chisel, likewise furnished with a long handle (*b*), and driven by a hand mallet, is very effective in taking off branches close to the stem or bole, in circumstances where the saw cannot be freely used from the upright direction of the branch, or the situation of the adjoining branches. Such are the manuals of forest-pruning. It may be justly said that in no one process of the culture of forest-trees is a just knowledge of vegetable physiology, or that of the structure and functions of the organs of vegetable life of more importance than in this one of pruning, which directly and especially applies to the assisting and directing, as well as the checking, of these functions in the production of wood as in forest-trees, and in that as well as of flowers and fruit in garden-trees. Some of the leading points of vegetable physiology which bear directly on the practice of pruning, have been mentioned in Chapter III., and full details may be obtained in the work there cited.

Fig. 12.



A timber tree, as before observed, is valued for the length, straightness, and solidity of its stem. Judicious pruning tends greatly to assist nature in the formation of the stem in this perfect state. In natural forests, boles or stems possessing properties of the most valuable kind are found, where no pruning, trenching, or any other process of culture ever was applied to the rearing of the trees. It should not, however, be concluded from this circumstance that these processes are of little value. If we examine the growth of trees in this climate, when left to the unassisted efforts of nature by the neglect of pruning and thinning, we find that but a small number only, on any given space of planted ground, attain to perfect maturity, compared to those which never arrive at any value but for fuel. The like results, though varying according to local advantages, are exhibited in the produce

of self-planted forests. Hence, instead of an average of two or three perfect trees on any given space (suppose an acre) left by the unassisted efforts of nature, we shall have from forty to three hundred perfect trees, according to the species of timber, by the judicious application of art in the preparation of the soil and the after culture of the trees, and probably on soils, too, which, without such assistance, could never have reared a single tree.

But though judicious pruning greatly assists in the production of a tall, straight bole, free from blemish, yet unless those circumstances before mentioned are favourable, as a vigorous, healthy constitution of the plant in its seedling stage of growth, transplantation to its timber sites at a proper age, and a soil suitably prepared and adapted to the species of tree, pruning will be found but of small efficacy*.

It was supposed that when branches are taken from a tree, so many organs of waste are cut off; and it has been practically insisted upon that, by the removal of large branches, the supply of sap and nourishment which went to their support would go to a proportionate increase of the stem. From what has already been stated respecting the course and movement of the sap, it may be unnecessary to add that this opinion is erroneous in principle, and that when a branch is cut off a portion of nourishment to the stem is cut off also specifically from that part of it which lies between the origin of the branch and the root, downwards to the root. Every branch of a tree, of whatever size it may be, not only draws nourishment and increase of substance from that part of the stem which stands under it, and from the roots, but also supplies these with a due proportion of nourishment in return, and by which their substance is increased. If the branch, whether large or small, acted merely as a drain on the vessels of the stem, and that the sap it derived from it was elevated to the leaves of the branch, and from thence returned no farther than to the origin or point of its union with the stem, then the above opinion would be correct: on the contrary, however, when it is found that the existence and increase of every twig, branch, and leaf, depends on a communication with the root, and that this communication passes through the stem downwards to that organ, and from it upwards periodically, and, moreover, that every periodical series of new vessels thus formed in the branch has a corre-

* At Blair Adam pruning was resorted to, in some instances, where the trees were too far advanced in age for that operation, but it was rendered necessary, in those instances, by due attention not having been paid to those portions of the wood at an earlier period. The rule then and there followed was, not to cut off any branch which left a horizontal surface exposed: they were cut so as to have the surface of the cut in the line of the stem, with a very sharp heavy bill, at the time the sap was rising: the effect of this was uniformly to secure a considerable growth of the bark over the wound before winter set in. This has obtained stem for the trees that were so treated, but it is greatly feared that when they are put to use, there may be weaknesses (in the dockyards called blanks) at the parts where the pruning has taken place.

To make valuable wood, length of stem is essential, and the practice at Blair Adam, in consequence of experience, has been to obtain this by knife pruning in the earlier years, by bill pruning as they grow older (say to twenty-five years, when the lateral branches are easily cut and soon barked over), then by leaving them to press upon each other more severely than vigorous thinners would permit.

Two effects seem to be produced by this:—First, they draw each other up to stem;—secondly, they produce a certain decay in the lower lateral branches. When those effects are sufficiently attained, and before any risk is incurred to the power of the tree to obtain thickness, the thinning is commenced by gradually, and according to the best judgment that can be formed, taking out the inferior trees and those best grown trees which injure each other, but taking care to do this so gradually as to secure against any chill or sudden effect of cold, so as to bring about (what may be called) the injury of being bark-bound,—the most effectual impediment to growth either in height or thickness.

sponding series of vessels formed in the stem from its point of emitting the branch to the root, it is clear that a branch not only increases in substance by the functions of its own organization, but must, of a necessity, periodically increase the substance or diameter of the trunk.

The results of practice agree with this; for if an overgrown limb or branch of a free-growing tree be pruned off, the annual increase of the diameter of the stem is not found to exceed its previous rate of increase; or the excess, if any, is not equal to the contents of wood which had been periodically formed by the branch or branches thus separated from the stem*.

It is reasonable to inquire, if the sap or nutritive fluid, periodically supplied by the roots immediately connected with the large branch taken off goes not to a proportionate increase of the stem, to what channel is it directed? It has already been mentioned (in Chapter III.) that the vessels which convey the periodical supply, and the roots which collect it, are annually produced; and the fact is, that when the primary organs and stimulus of production, (i. e. the leaves and green system of the plant,) are taken away, the annual rootlets and spongeols connected with these vessels cease to be renewed, until another branch, or series of branches, are reproduced by the vital power acting on the sap in the vessels of the stem connected with the numerous latent germs of buds in the bark near to the wound, or those dispersed in its neighbourhood. Hence it is, also, that should the season of the year of pruning the branch be that in which the sap is accumulated in the largest quantity in the leaves, and in the smallest proportion in the vessels, scarcely any reproduction of branches follows the operation of pruning; and hence, also, the different effects of summer and of winter pruning as regards this point.

When branches are not allowed to perfect one year's growth, but are pruned off annually within a bud or two of their origin with the stem, they act rather as organs of waste than those of increase of wood to the stem. But although the rate of periodical increase of the diameter of a tree be thus lessened, in a certain extent, by the loss of a full grown lateral branch, yet the increase of the stem in height or length is not thereby retarded, the ligneous vessels of the root corresponding with those of the stem or wood, probably act with but little diminished force in sending up sap to the higher extremities of the tree†.

It is of great importance that branches which indicate an over-luxuriant growth should never be suffered to become large, or to exceed the medium size of the majority of the boughs of the tree, but should be pruned off close to the stem when the general interests of the plant will admit of it. These over-luxuriant branches, which, when suffered to take the lead in growth of the general boughs, become so hurtful to the perfection of growth of the stem, are evidently produced and supported by the accidental circumstance of a superior portion of soil being in the way of,

* In numerous and varied trials made by the writer to ascertain this point, the results have always gone to prove the above facts.

† In a few instances, for the sake of particular effect, and to enable carriages to pass, there have been, at Blair Adam, limbs of considerable size cut from oaks of fifty years old and upwards. The cut would have been horizontal; but by making the surface of much greater size, they were made perpendicular. By great attention, all injury was prevented to the trunk, and the wounds are now healed over (at the distance of twelve or fifteen years from the date of the operation). Whether it has accelerated or retarded the diameter-growth or thickness of the trees cannot be stated, as observatian was not called to it, but they have certainly increased as much in that respect as the trees around them of the same sort and age. In one instance, the cutting of a limb, where the tree cleft, has had the effect of setting the other stem upright, so that it appears now exactly in the perpendicular line, and like the original stem of the tree.

and into which the roots immediately connected with these boughs penetrate and afterwards keep possession. By taking off such branches early, therefore, the extra supply of nourishment afforded by such local circumstance of soil is directed to the stem and useful lateral branches.

It has been already observed, that, by depriving a tree, to a certain extent, of its side branches, the growth of the stem in length is promoted, but the diameter, strength, or thickness of it is not increased in the same proportion. When the side branches are destroyed by natural causes, or by the neglect of judicious thinning, the like injurious effects ensue to the primary object here in view, that of obtaining the largest quantity of timber of the best quality on a given space of land.

When the lateral branches perish or cease to be produced, except towards the top of the tree, from the want of pure air and of the vital influence of the solar rays on the foliage, the existence of the tree may continue for years, but the produce or increase of timber of any value ceases, and it dies prematurely, affording at last a produce comparatively of no value, after having obstructed the profitable and healthy growth of the adjoining trees during its latter unprofitable stages of life. In the contest for the preservation of existence which takes place after a certain period of growth among the individual trees of a plantation which has been neglected, or left without the aid of judicious pruning or thinning, there will be found trees which, from the accidental circumstance of having originally a vigorous, healthy constitution, and from partially escaping the numerous injuries and obstructions of growth that accrue to trees by neglect of culture, have attained to a valuable timber size. The timber of the few such trees, however, as have thus gained the supremacy, is frequently much blemished by the stumps of the dead branches having become imbedded in the wood; and this serious injury to the quality of the timber and value of the tree, is the invariable consequence of neglecting to prune off these stumps as soon as they appear, or rather neglecting to cut away close to the stem such branches as indicate decay, and before they cease growing.

The time at which pruning should begin, depends entirely on the growth of the young trees. In some instances of favourable soil and quick growth of the plants, branches will be found in the course of four or five years to require foreshortening, and in case of the formation of forked leaders, to be pruned off close to the stem. When the lateral branches of different trees interfere with each other's growth, pruning, so as to foreshorten, should be freely applied in every case, in order to prevent the stagnation of air among the branches, or the undue preponderance of branches on one side of the tree. Perfect culture, in this respect, requires that the plantation should be examined every year, and by keeping the trees thus in perfect order there will never be any danger of making too great an opening, or depriving a tree too suddenly of a large proportion of branches. The operation will also be so much more quickly performed, as to render the expense of management less than if the pruning were delayed, or only performed at intervals of years, as is too frequently practised. By this management there will be little, if any, necessity for pruning close to the stem, until the tree attain to twenty feet in height, or even more than that, provided the stem be clear of lateral branches from five to eight feet from the root. When the lateral branches are regular and moderately large, the smaller length of clear stem may be adopted, and where the branches are larger towards the top, the greater space of close pruning. Five years from the first close pruning will not be too long before the second is performed; one, or at most, two tire of branches

may then be displaced in like manner. The increase of diameter of the stem, is the only certain test for deciding whether the larger or smaller number of branches may be pruned off to most advantage, or whether it may be prudent to take any away from the stem until it attain greater strength and thickness. By examining the trees of a plantation annually, the critical time for pruning every branch for the best interest of the trees is secured. Some trees may be pruned with great advantage successively for years, whilst others may only require it every three or five years, and others again not at all.

It has been disputed whether resinous or non re-productive trees are benefited by pruning; but the value of judicious close pruning to that tribe of trees cannot be doubted: at the same time it is but too true that, in numerous instances, it has been carried to a mischievous excess. Young firs and larch trees, when deprived of their lateral branches, to within four or five tire of shoots of the top, are frequently seriously injured by the winds acting on the tuft of branches, which become as a lever loosening the roots, and producing all the evils of a suddenly checked growth, besides those of excessive bleeding or loss of the resinous sap, and the want of the periodical supply of nourishment to the stem afforded by these branches. At sixteen years of growth, larches standing at four feet apart, will be benefited by moderate pruning; *i. e.*, of two or three tire of the lowermost branches, particularly should these appear to be *decreasing* in their former vigour of growth; and afterwards in every third or fourth year, successively, the like treatment should be adopted to these lowermost branches evincing a decline of healthy growth. The same rule applies to the pine or Scotch fir and the spruce; but the former, having large and compound branches, should be pruned at an earlier age than the latter, or before the lateral shoots are more than two inches in diameter. When the branch to be taken off is several inches in diameter, the wound is so large, the excavation of resinous sap so great, and the heart-wood, or the vessels which constitute it, so indurated, as to render the perfect union of the new and the old wood less certain than in young branches, all which make the removal of large branches productive of more evil than service t the growth of the tree and quality of the timber. On the contrary, when the pruning of the pine is altogether neglected, and the dead or rotten stumps or snags of branches are left to be embedded in the wood, or to form cavities for the accumulation of water or other extraneous matters in the substance of the stem, all the purposes of profit and of pleasure are sacrificed to neglect or unskilful culture.

Judicious thinning may be said to be productive of the same valuable effects to a plantation of timber-trees in the aggregate, as those which judicious pruning produces on every individual tree composing it: by the admission of a proper circulation of air and the solar rays, and permitting the free expansion of the essential lateral branches of the trees, as well as by preventing an unnecessary waste or exhaustion of the soil by the roots of all supernumerary trees.

The great advantages of judicious thinning are not confined to the object of obtaining the largest quantity of timber of the best quality on a given space of land in the shortest space of time; but the produce of the trees thus thinned out ought to afford a return sufficient to pay the expenses of culture, interest of capital, and the value of the rent of the land. In many instances the profits arising from the thinnings of well managed woods have covered these charges before the period of twenty years from the time of planting. The time at which the process of thinning should be commenced, depends on the like causes as those which regulate pruning, and need not here be repeated.

In general the freest growing plantations require to have a certain number of trees taken out by the time they have attained to eight years of growth from planting. On forest-tree soils of a medium quality, the age of ten or twelve years may be attained by the young trees before thinning is necessary; but should fifteen years elapse before the trees demand thinning, it will be found that the plantation has been imperfectly formed.

No certain rule can be given to determine the number of trees to be thinned out periodically, which will apply to all plantations and to every kind of forest-tree in them. A well-grounded knowledge of the principles of vegetable physiology, and of the habits of trees, is absolutely essential, to execute with success this very important branch of arboriculture. We may, however, quote the following statement from practice as one example, taken from an average of acres on an extensive plantation in Sussex:

One acre of siliceous sandy soil, worth 7*s.* per acre, when under pasturage, being properly prepared and planted with larch, at three feet and a half apart, required thinning for the first time, when the trees had attained to ten years of growth.

Number of trees when planted 3555 on one acre, of which 100 had failed during the first ten years of growth; therefore when the thinning commenced the number was 3455.

Number of Years Growth when thinned.	Number of Trees left on each occasion of thinning.	Distance of the Trees. Ft.	In.	Number of Trees thinned out.		*s.*	*d.*	Value. *l.*	*s.*	*d.*
10	3097	3	9	100	worth	0	4 each.	4	13	0
				200		0	3			
				58		0	2			
				100 vacancies from accidents.						
15	2722	4	0	55		0	10	7	4	2
				100		0	6			
				120		0	4			
				100		0	1			
20	2411	4	3	20		1	6	8	17	8
				91		1	0			
				150		0	4			
				50	fuel	6	8			
27	2073	4	7	20	worth	2	0	13	14	0
				25		1	6			
				100		1	0			
				193		0	6			
35	1440	5	6	25		2	6	32	3	3
				100		1	6			
				275		1	0			
				233		0	9			
43	1031	6	6	30	worth	3	0 each.	32	4	0
				50		2	6			
				200		1	6			
				129		1	0			
51	680	8	0	40		3	6	37	11	0
				100		2	6			
				150		2	0			
				61		1	0			

The future returns of income from the plantation, now rest on six hundred and eighty trees nearly arrived at their perfection of growth. The distance of nine feet apart is considered a sufficient space for the larch,

spruce, and silver firs, to attain to their maximum of timber growth, on soils of an average quality adapted to their habits; and as the above trees may profitably occupy the soil for twenty or thirty years more, or without ceasing to produce timber annually for that period, the thinning now should depend on, or be regulated by, the circumstances of demand for the produce, more than for the benefit of the individual trees which remain.

In the above details of thinning, it will seem to demand an explanation, why certain trees of the lowest value at fifty years' growth should have been left apparently to encumber the ground, while trees of a value equal to these are cut down at ten years' of growth. The answer to this question brings us back again to the difficulties before alluded to, of giving any data, or rules applicable in all cases, founded on number, size, distance and time, for the execution of the different processes of culture, relative to assisting and controlling the functions of vegetable life, so as to produce a given result, or obtain a specified quantity of timber from certain trees under different circumstances of soil, site, local climate, and culture.

If all trees were produced from seed with the same degree of constitutional strength, and were the soils on which they might be planted of the like nature throughout, and under equal circumstances with regard to moisture and exposure, as well as to every other influential point, then statical rules of practice for the culture of trees might with equal certainty be given, and of as general an application to suit every variety of case, as those for the execution of any mechanical art: but the reverse of all this is the fact; and every variation in the soil, and in the exposure and growth of the trees, must be met with a corresponding variation in the process of culture, as regards the number of trees to be thinned out, the distances at which they should stand, and their size and age. The trees above mentioned, which at fifty years' growth were not of greater value for the purposes of timber, than several trees thinned out at ten, assisted the growth of the more valuable trees, which immediately or more remotely adjoined them, by the shelter they afforded against cutting winds, and by ameliorating the local climate, to that degree as to fully warrant their continuance. Those trees which were of equal value to these when cut down at ten years' of growth, stood so close to others of greater promising value as to injure the growth of both, and had they been suffered to remain, would have prevented some of the most valuable trees of the plantation from attaining to perfection. Thus, on the one hand, by removing the former description of plants, the most valuable trees are promoted in growth, and on the other preserved from injury, by suffering less valuable ones to remain.

Various tables have been calculated to assist in deciding on the number of trees to be thinned out of plantations at stated periods; one of these by Mr. Waistell*, appears to be brought to as near a correct average, as the nature of the subject will permit.

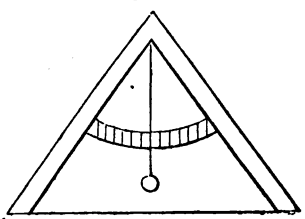
'The following table shews the number of trees to be cut out in thinning woods, and the number left standing at every period of four years, from twenty to sixty-four years, reckoning that the distance of trees from each other should be one-fifth of their height, and that the trees should have increased twelve inches in height, and one inch in circumference annually, and to have been at first planted four feet apart.'

* Transactions of the Society of Arts, vol. xxvi., and Withers's 'Memoir on planting and rearing Forest-trees,' p. 37.

Years old and feet high.	Girt.	Contents. Ft.	In.	Pts.	Distances.	Number of Trees on an Acre.	Contents of the whole in feet.	Number to be cut out.	Contents. Feet.
20	2½	0	10	5	4.	2722	2362	839	727
24	3	1	6	0	4.8	1883	2824	494	741
28	3½	2	4	7	5.6	1389	3308	326	776
32	4	3	6	8	6.4	1063	3779	223	792
36	4½	5	0	9	7.2	840	4252	160	810
40	5	6	11	4	8.	680	4722	118	819
44	5½	9	2	11	8.8	562	5194	90	831
48	6	12	0	0	9.6	472	5664	70	840
52	6½	15	3	0	10.4	402	6130	55	838
56	7	19	0	8	11.2	347	6611	45	857
60	7	23	5	2	12.	302	7076	37	866
64	8	28	5	4	12.8	265	7537		

When there is a deficiency of access to certain parts of the plantation; and additional rides or drives must be made, the lines should be marked out by barking the trees in the course of it, or; what is better, by a circular mark with whitewash or lime. The roots should be grubbed up, and the surface of the ground prepared and sown with the seeds mentioned in Chapter V. When there are steeps or hills, the drives should be formed with the most easy ascent for the convenience of timber carts. The ascent ought not to be greater than one foot in thirty. The most useful instrument for determining the ascent or descent of forest drives, is constructed in the form of the common level, furnished with an index divided into ninety degrees. When the plummet line hangs at the forty-fifth degree, the legs of the instrument indicate a perfect level (*fig.* 10), and when it hangs at a lesser or greater number, it indicates the degree of ascent or descent accordingly. In plantations the thinning of which has been neglected, the trees next the sides of the drives are always the largest and most valuable, and afford a test at all times to judge how far judicious thinning has been practised or neglected. When this essential part of culture has been neglected, the greatest caution is necessary in performing the work. The trees being grown up slender, weak, and deficient of side branches, a too sudden exposure to the winds or currents of air, will be found injurious, if not fatal. The outside trees should be continued in their thicket state for several years after the first relief is given to the interior trees, and even then should only be deprived of decaying companions, or of branches unnecessary for the purposes of shelter, but which it may be advantageous for the trees to lose. Trees weakened by growing in a crowded state, become more obnoxious to disease, and to the attacks of insects, and to that of parasitic plants, such as mosses and lichens, which rarely or never appear on healthy and vigorous trees. The number of trees to be taken out on the first occasion of the thinning of a neglected plantation should be very limited, and confined to those which have become the most exhausted. The process should be carried on for six or seven years, until completed. The pruning of such trees should be confined to the removal of decaying or dead branches, until the gradual introduction of fresh air, and the solar rays by the thinning process has renewed lateral shoots and invigorated the branches*. Forest-trees are, like other organized bodies, confined to a

Fig. 10.



* It is a great error to suppose, that by leaving trees in an individually crowded state, the object of a close cover is secured; on the contrary, this object will only be gained for

certain period of existence, in which the stages of growth are distinctly marked, from the first development of the plant in its seedling state, until its ultimate decay by the course of nature. Different species of trees have different periods of existence. The oak is considered to be of the longest duration, and, perhaps, the larch of the shortest. The oaks in Woburn Park, mentioned at page 50, as being of such large dimensions and in perfect health, cannot be supposed to be under three hundred years of age. The elm may be placed next in order with the chestnut, ash, beech, and hornbeam, the pine, and lastly the larch*. These estimates of the comparative duration of different species of trees are, however, given from observation only, and are not founded on such certain data as to render them more than an approximation to the truth; for soils, local climates, and the various other causes which promote or retard the progress of vegetable health and growth, interfere with the completion of the perfect, natural term of vegetable life in numerous instances. Under the most favourable circumstances, however, of soil and culture, trees are subject to various diseases and accidents, and from what has already been mentioned, as to their structure and living functions, this will be no matter of surprise. The diseases of forest-trees may be comprised under those of a general nature, wherein the internal functions are interrupted or partially destroyed; and secondly, those of a local nature arising from external causes, as accidents of various kinds, and the attacks of insects. Neglect of judicious planting and of after culture, are the chief causes of the first mentioned kinds of disease, and tend to aggravate the bad effects of other accidents. When a tree puts forth leaves of paler tint than their natural green colour, and never assumes it again during that and succeeding seasons, and when the growth of the branches is very small and frequently imperceptible, some of them also decaying at the extremities, the disease is termed *chlorosis*. It originates principally from an ungenial subsoil. The effects of confined air by a crowded state of the plantation, or a too sudden exposure to sharp blasts, will also induce this disease. Topical remedies are of no use, and the means of prevention should be used in planting, and in the after culture.

Spontaneous bleeding, or great loss of sap, generally ends in the disease termed *tabes*, which, when once confirmed, is incapable of being cured. The elm is of all forest-trees the most subject to this disease. Whenever the branches become disproportionate to the stem and roots, or the foliage too scanty to receive and elaborate the periodical flow of sap, spontaneous bleeding takes place. The neglected stumps of dead branches having formed cavities, afford ready outlets to the sap. Branches which have been suffered to grow too large in proportion to the rest of the tree, and are bent down or project in an horizontal direction from the stem, are frequently attacked with *hæmorrhagy*, which, according to our observation and experience, never heals, but continues periodically until the death of the tree. The fluid which is thus discharged by the elm, appears to differ in no respect from the ascending sap of the plant, affording extractive and mucilaginous matters, combined with potassa and lime; the solid matter deposited by the fluid in its course of descent over the bark, leaves a whitish tract at first, but in time becomes blackened by the weather, smoke, &c. The track thus marked out by the hæmorrhage, will point out the wound with certainty and readiness. Grass and herbage on which this fluid drops

a few years at first, or until the trees interfere with each other's healthy growth, and begin to contend for existence. By judicious pruning and thinning, or by keeping any individual tree in its most perfect healthy state, a perpetual cover will be obtained, as complete as the species of tree and the nature of the soil will admit.

* The Pinus Lambertia before mentioned, found on the north-west coast of America, was estimated of nine hundred years' growth, although sound in the timber.

is destroyed by it. When there is made a strong effort of the functions of the plant to heal up the wound, and, after it is almost wholly closed with healthy bark, a substance of a dark colour and resinous appearance is exuded. This substance is termed *ulmin;* as a pigment it produces the most beautiful brown, and appears to consist of a peculiar extractive matter and potassa*. The oak, under the like circumstances, exudes a substance having similar external characters. The birch and maple, when cut or lacerated through the bark into the wood, suffer much from the loss of sap which flows from such wounds.

The pine and fir tribe of trees have a resinous juice, which exudes freely from wounds of the bark. When large branches are injudiciously pruned off, the injury is considerable from the waste of sap. In the cases of full-grown trees of the elm being affected with this disease, the best course is to take them down for timber; but where it is desirable to preserve the tree for landscape or ornamental effect, the decayed stumps should be cut away close to the sound bark, and the wound dressed carefully to protect it from the weather. If a cavity exists out of which the sap has, for a considerable period, been in the habit of exuding, the aperture should be cleared of the dead bark covering its sides, and then the mouth should be securely closed by the composition before recommended, or by any other substance that may be found more effectual to prevent the admission of rain, and of air. Whatever tends to increase the number of healthy branches and leaves on the tree, will the most effectually restrain the disease.

Tabes, or the wasting of trees, is brought on not unfrequently by parasitical plants, as ivy, covering the cutis of the barks, and preventing the healthy functions of that organ. The loss of the green colour of the leaves, the gradual wasting of the branches, and diminution of the foliage, indicate the confirmation of the disease. If taken in time the remedy of cutting the ivy at the root is speedy and effectual. When lichens pervade not only the stems but the branches of trees, the functions of the bark are disturbed, and disease ensues. On damp soils, where proper thinning is neglected, lichens and mosses propagate to the extremities of the branches, and flourish in a surprising degree. Caustic lime water thrown upon the parasites will destroy them without injuring the tree, provided it be done during the fall of the leaf. A hand-engine will apply the lime water to a great many trees in the course of one day. The necessity of topical applications, however, of this sort for forest-trees, ought to be avoided by timely thinning and pruning, thereby admitting a circulation of pure air, and the solar rays into the interior of the plantation, which check the propagation and growth of parasites.

The number of different species of insects which infest forest-trees is very great; they are all productive of more or less injury to the growth of the plants. The most destructive are:—

			Time they appear.
**Noctua pinastri*, Lin.	*xylena, Hüb.*	pine moth	June.
fimbria	oak moth		August.
pyramidea	copper underwing	oaks	,,
macilenta	brickmoth	elms	,,
citrago	sallow moth	limes	,,
alniaria	canary-shouldered moth	limes	,,
erosaria		limes	September.
olivaria	green carpet moth	birch	August.
betulitana			,,

* Agricultural Chemistry, p. 105. Ulmin is elsewhere stated to be an acid *sui generis*, and, like other vegetable acids, to be a compound of carbon, hydrogen, and oxygen—that it combines with potassa like an acid, and is again precipitated from it by acids having a stronger affinity for potassa.

Noctua	*rapezana*	diamond-back moth	August
	iciana	white backed willow	„
	upsilon	dismal moth	„
	retusa	double kidney moth	„
	nupta	red underwing	„
**Scolytus*	*destructor*	bark beetle	oak and elm March.
**Lasiocampa*	*quercus*	egger moth	oak July.
	crataegi	hawthorn moth	white thorn „
**Coccus*	*lariceo*	larch scale	larch „
	abietis	spruce fir bug	fir „
	aceris	maple bug	maple „
	alni	alder bug	alder „
	betulæ	birch bug	birch „
	quercus	oak bug,	oaks June, July.
	salicis	willow bug	willows June, July.
	tiliæ	lime bug	limes June, July.
	carpini	hornbeam bug	hornbeams June, July.
	capreæ	crack willow bug	salix caprea June, July.
	oxycanthæ	thorn fly	white thorn „
Aphis	*ulmi*	elm fly	elm June, Aug.
	quercus	oak fly	oaks „
	pini	pine fly	pines „
	tiliæ	lime fly	limes „
	fraxini	ash fly	ash-tree „
	betulæ	birch fly	birch-tree „
	fagi	beech fly	beech-tree „
	aln	alder fly	alders „
	salicis	willow fly	willows „
	bursaria	black poplar fly	black poplar „
	aceris platanoides	maple fly	maples „
Cynips	*quercus folii*	gall fly	oak „

The pine moth nestles in the leading bud of the pine, and destroys its principal shoot. The attack of this insect often injures a whole plantation, as they propagate fast, and prefer the terminal bud of the stem. If on the first appearance of the insect, or before it had affected more than two or three trees, means were immediately had recourse to for destroying them, and guarding every season to prevent them from establishing themselves in numbers, the prevention of their ravages would be thus effected at a moderate cost of labour or expense.

The *scolytus destructor* is a formidable insect. It penetrates through the bark into the alburnum, on which it feeds, destroying the organization of the bark, and annihilating its functions. In time the bark separates in large masses from the wood, and the tree dies. The elm is most obnoxious to this insect *. The pine is also subject to attacks of the same kind, and attended with the like fatal effects.

* It has been supposed to be the effect of disease rather than the cause of it, or of living on the dead and decaying juices; but when we never find the insect in life on a dead tree, but always on a living one, and that oftentimes in the full vigour of health, we cannot conclude otherwise than that the *scolytus destructor*, if not the only cause of *tabes* or a wasting of the plant, is one of the primary ones, and is never an effect. Very recently a number of elm trees, of a considerable age and size, in the neighbourhood of Camberwell, died in a very rapid manner. The bark became detached from the stem, and fell off in large pieces, or could with small force be removed by the fingers for a space of five feet from the root upwards.

The bark was perforated by the scolytus in numerous instances, and their ravages on the alburnum were evident by crowded tracks through its substance. There were a very few of the trees which escaped destruction; but even these had perforations of the bark,

The larva of the *lasiocampa quercus* sometimes strip the leaves entirely of the branches of the oak. When the trees are young, and the attack is perceived before it has made great progress, the application of caustic lime water, served by the hand-engine before mentioned, is the only topical application we have found practicable, as regards cost, time, and effectiveness.

The different species of coccus or scale-like insects which infest most trees, seldom attain to such numbers as to endanger seriously the health of forest-trees.

The aphis or fly is more common and injurious. Almost every distinct species of tree has a species of aphis peculiar to itself. The glutinous substance which, in hot arid weather, appears so general on the upper surface of the leaves of trees, is produced by these insects. This substance, by attracting other insects, and by arresting smoke and dust on the surface of the leaves, prevents the leaves from performing their healthy functions. For large trees and extensive plantations topical remedies are of course out of the question. In confined cases a solution of soft soap, or of water impregnated with caustic lime and sulphur, are either of them very effectual cures.

The gall fly (*cynips quercus folii*) deposits its eggs in the membrane of the leaves of the oak, and produces those tumours on the leaves called oak galls. The extent of injury inflicted on the general health of the tree has never been observed to be great, or such as to warrant any expensive trial for a cure.

The last disease, or rather defect, that may be mentioned here, is termed *shake*, and should be carefully guarded against in the culture of forest-trees. Trees, though outwardly to all appearance sound in the stem, are often found with splits of several feet in height from the root upwards. This is frequently caused by strongly bending the stem of a tree from the top when young. The stem of trees in plantations which have been neglected in judicious thinning and pruning, being tall and slender in proportion to the branches of the top, these act as a lever to the wind, and in time produce this blemish in the timber. In carrying out

although in smaller number. Before the bark began to peel off, gas pipes had been laid near the foot of one row of the elms, the time had been only about six weeks, and the mischief was imputed to the escape of the gas among the roots. This reason, however, was untenable, inasmuch as trees removed to a considerable distance from the gas pipes were equally affected; while a few already mentioned adjoining it escaped. Besides, the foliage shewed no signs of being affected, which all gaseous poisons have the immediate effect of shewing first on the leaves. In this instance the state of the trees, previous to the introduction of the gas pipes near to the roots, showed that the *scolytus destructor* had been one of the several causes that produced the death of the trees. These elms were in rows, and formed an avenue. They had been planted too close in the rows, and had also been neglected in thinning and pruning. The remains of dead stumps, and the numerous cavities left by others, marked out by the discoloured traces on the bark of the long existence of an yearly hæmorrhage of sap, and also the scanty tops in proportion to the size of the stems, all proved that the disease *tabes* had been confirmed. Add to this the bad effects of drains, and deep foundations cut out in the immediate neighbourhood of the trees, accompanied by two excessively dry seasons (1825 and 1826) so favourable for the propagation of the *scolytus destructor*, and the crisis and results of the disease will not be any subject of wonder. A tree of the *pinus pinaster*, which had been reared in a pot, was subjected to the influence of gas the same as that supplied to the roots of the elm, but without producing any perceptible effect. A large ox bladder was filled by the writer of this with the carburetted hydrogen gas, and connected by a pipe with the draining aperture of the pot, in which the roots of the pine were confined. This quantity of gas was made to pass through the earth in the pot during the space of forty-eight hours, and renewed and continued for three weeks; but, as just now observed, without producing any ill effects on the health of the plant. The pine is liable to be injured and destroyed by the insects before mentioned, in the same manner as the elm.

the produce of the thinning of a plantation, as well as in executing the work in a careless manner, the same bad effects are not unfrequently produced in young saplings. The decay which is observed at the lower end of the stems of larch trees, when planted on chalk, or on very damp clay, is clearly the fault of the subsoil, and sometimes appears when the tree is only eighteen years old. In numerous instances we have found it commence at the seventh year's annual layer of wood, and never earlier, and to extend to the thirty-fifth year's layer, but not beyond that growth. In all our observations it appeared to be either within seven and thirty, or thirty and thirty-five years' layers. The fungus, which appears in the defective wood, commences at the higher portion of the main branch of the root connected with the annual layer affected, and proceeds upwards. Its characters are extremely similar to those of the *dry rot* (*merulius destructens*), so much so, that until more minute observation determine to the contrary, they must be considered identical. It is highly probable, therefore, that the *dry rot* exists in the interior of timber, while the tree is yet growing, although possibly in too inert a state to be distinguished by the naked eye. In the living plant no remedy has yet been discovered for this disease. Judicious planting will ensure prevention by furnishing each distinct variety of soil and subsoil with those species of forest-trees only which are best adapted to them; and this principle, whether in the herbaceous plants of husbandry, in fruit trees in gardening, or in timber trees in forest planting, is never violated with impunity. Various means have been tried, from time to time, to prevent the appearance of dry rot in timber, as well as to arrest its progress when once begun. The first of these objects is supposed to be gained by *seasoning* the timber previously to using it. Some recommend the bark to be taken off the tree to a certain height a year before it is felled, and the practice has been tried long ago on the oak *, and more recently with the larch. It would appear, however, in the latter case, that when the trees are young, the alburnum or sap wood becomes soft rather than hard under the process.

Another mode of seasoning timber is by immersing the trees in water for a period of one or more years. This practice is considered very beneficial, but it is clear that the necessary proofs cannot be obtained under a period of many years comparative trials of seasoned and unseasoned wood in the same building, and under the same circumstances in the building. The seasoning of wood by subjecting it to a strong heat by means of steam has also been tried, but, as in the former case, time is required to determine its efficacy. When wood is left to the process of nature to become seasoned, the desired effects are more perfectly produced by protecting the wood from rain and sun. Knowles, in his Essay on Dry Rot, recommends the timber to be 'kept in air neither very dry nor very moist; and to protect it from the sun and rain by a roof raised sufficiently high over it, so as to prevent by this, and other means, a rapid rush of air.' Confined air and a moist temperature encourage the propagation and growth of the *merulius destructens* in a high degree. When unseasoned wood is painted, the latent seeds of the dry rot are thereby encouraged and assisted in vegetating and spreading the fungus or algæ with destructive rapidity.

The proper season for cutting down timber-trees is that in which the sap is most quiescent, *viz.*, midwinter and midsummer; but particularly the

* In 1737 Buffon disbarked three oak-trees, forty feet in height, where they stood, and they remained in that state for three years; they were then cut down, and the results were found to be in favour of the practice.

former. Trees whose bark is valuable require to be felled before the complete expansion of the leaf. From the middle of April to the end of June is the proper time for the oak; the larch should be peeled earlier. The birch having a tough outer cuticle of no use to the tanner, and as this is more easily separated from the proper bark after the sap has partially circulated in the leaves, it is generally left standing until the other species of trees are felled and barked.

The process of barking is, in general, well understood. The harvesting of the bark is of the greatest importance, for if it be suffered to heat or ferment, it loses its colour, becomes mouldy and of little value. The best mode is to make what the foresters term temporary lofts of about two feet in width, and of a length sufficient to hold a day's peeling of bark. These lofts are formed by driving forked stakes into the ground for bearers, about three feet in height in the back row, and two and a half feet in the front; a sloping floor is then constructed by laying loppings between the forks of the bearers. The bark is then placed on the sloping floor with the thick ends towards the top or higher side, the smaller bark is laid on to the depth of six or ten inches, and the broad pieces placed over the whole as a covering to carry off the wet, should rain happen before the bark is sufficiently dry to be stacked. In three or four days it should be turned to prevent heating or moulding, and in ten days, more or less, it will be sufficiently dry to be stacked until wanted for the tanner. In order to prevent fermenting when stacked, the width of the pile should not exceed eight feet. The roof should be formed and thatched as a corn or hay stack. In preparing the bark when ready for the tanner, it is cut into pieces about three inches in length, and weighed. It is sold by weight.

The quantity of tannin contained in the bark of different forest-trees has been ascertained by Sir Humphry Davy, and although the proportion of tannin afforded by the bark varies according as the spring may be favourable in temperature, the following numbers will be found to express nearly their relative values, if the larch cut in autumn be excepted :—

Average of entire bark of middle-sized oak, cut in spring	29
of Spanish chestnut	21
of Leicester willow, large size	33
of elm	13
of common willow, large	11
of ash	16
of beech	10
of horse-chestnut	9
of sycamore	11
of Lombardy poplar	15
of birch	8
of hazel	14
of black thorn	16
of coppice oak	32
of oak cut in autumn	21
of larch cut in autumn	8
white interior cortical layers of oak bark	72*

In general the bark of the larch is not worth more than half the price of oak bark, and the proportion given to larch in the above table may, therefore, be considered too small. The great disproportion between the produce of tannin afforded by the inner bark and that of outer layers, shews with what care the harvesting of the bark should be performed to prevent

* Agricultural Chemistry, p. 79.

fermentation, which destroys the tannin principle first in that portion of the bark containing it in the largest quantity.

The weight of bark afforded by given contents of timber, varies according to circumstances connected with the growth of particular trees, as whether grown in confined air, or in healthy, open situations, also as regards the age of the trees. The statements given by Mr. Monteith, in his 'Planter's Guide,' are, perhaps, as near to the truth of an average as the nature of the subject will admit, at least they are consonant with the results of our own practical experience.

	Every cubic foot of timber affords of bark lbs.	lbs.
An oak 40 years old	from 9 to	12
Ditto from 80 to 100 ditto	„ 10 „	16
Larch timber, per foot	„ 8 „	10
Birch timber, large ditto	„ 11 „	14
Willow, ditto	„ 9 „	11

The most judicious mode of felling forest-trees is by grubbing up, or taking the solid part of the root with the bole, in every case where coppice stools are not wanted, for the expense of taking up the roots afterwards when either planting or tillage may be demanded on the sites of the felled trees, will be found to exceed that of taking up the root with the stem in the first instance, besides the injury to the immediate fertility of the soil by the introduction of fungi and insects, the first agents generally of decomposition of the roots of felled trees which do not stole or reproduce shoots. Besides the advantages now alluded to, there is another, that of the value of the solid part of the roots of trees. The peculiar structure of many roots afford the best materials for what is termed ornamental rustic work; and also the compact texture of the wood, and the diversified lines of the medullary rays and concentric circles, fit it for the manufacture of very interesting cabinet works.

The root of the larch affords a valuable material for forming knees of boats. Admiral Fleming was the first, we believe, to point out this property of the larch. The lower part of the stem, with the solid root attached, is quartered, and, when joined, form knees of a lasting nature,—that part of the wood, the solid root produced under ground, and always in contact with damp, being probably more adapted to withstand the effects of moisture than the proper wood produced in the open air.

Chapter VII.

Of the progressive increase of size or produce of wood in different species of forest-trees. Of the mode of valuing plantations—present value —prospective value of certain individual trees which have attained to great maturity. Of the products of plantations, and of the terms used by foresters to denote these products.

It is a common observation, that the slower a tree grows the harder is its wood. This statement, as applicable to trees of different species or genera, as, for instance, between the poplar and the oak, is generally correct, but between individual trees of the same species, two oaks, for example, the observation will be found not to apply; indeed the reverse will be found proved if we examine into the facts which bear directly on the point. In every plantation we find that the individual trees composing it vary considerably in what is termed quick or slow growth,

and that in all plantations where the pruning and thinning have not been judiciously executed, the trees which stand on the outside of the plantation, or on the sides of the drives, are larger, say double the size, or have been of much quicker growth than those in the interior of the plantation. Now the greatest comparative degree of strength and hardness of the woods of the two trees is proved to be in that of the larger, or the tree whose growth was most rapid and vigorous—the sap wood being of course larger in the fast-growing tree, as are all the annual layers of the heart wood. If the reader will look back to page 8, where the structure of the wood of different species of trees is described and figured, it will be seen that the wood of the oak, a comparatively slow-growing tree, is distinguished from the wood of the poplar, a fast-growing tree, by having the cellular structure comparatively confined to the concentric circles which mark the annual increase of wood; that the number of cells between these concentric circles are few, though of a larger diameter, while in the wood of the poplar they are dispersed in great number, or crowd the whole surface of a section of the wood. If the hard wood of the locust (*fig. n*, p. 10) be compared to the soft wood of the fir (*fig. o*), to the laburnum (*fig. q*), the lime (*fig. p*, p. 11), sweet chestnut (*fig. e*), to the horse-chestnut (*fig. h*), and every hard and durable wood to the soft and non-lasting kinds, the same clear and marked distinction will be evident, *i. e.* the hard, tough, and durable woods have the cells chiefly confined to the annual rings, or thinly scattered in irregular groups, leaving comparatively wide intervals of apparently solid fibre, while all the soft or non-lasting woods have the entire substance pervaded with minuter cells, in number and regularity that may be compared to the texture of fine lace or net work.

These then are the external discriminating characters of hard and of soft woods; and let us now apply these to distinguish the woods of fast and of slow growing trees of the *same species*, and we find that the wood of the fast-growing tree has wider intervals between the concentric circles, or congeries of cells, or, in a word, fewer cells to the size or diameter of the wood, and is consequently wood of greater strength, toughness, and durability. The experiments of Professor Barlow on the strength of different woods confirm the above conclusions*. The opinion of Thomas

* Mr. Withers, in his Letter to Sir H. Stewart, p. 115, states, that he received from Mr. Boorne, of Erpingham, a respectable timber-merchant, two specimens of oak, one taken from a fast, and the other from a slow growing tree. No. 1. was grown upon a very *strong good soil*, the age of the tree about sixty years, and it contained from thirty-eight to forty feet of timber. No. 2 was about one hundred and twenty years old, and was grown upon a light soil, with gravel about two feet below the surface. These specimens being submitted to Professor Barlow, of the Royal Academy, Woolwich, were tried, and gave the following results:—

Specific gravity.	Deflected one-fiftieth of its length with	Broken with	Comparative strength.
	No. 1.		
903	660lbs.	999lbs.	1561.
	No. 2.		
856	414lbs.	677lbs.	1058lbs.

No. 1, it appears, is, therefore, of about medium strength, my mean number being for English oak, 1470.

No. 2 is very weak, my weakest specimen being 1205. (See Essay on Strength of Timber.)

Mr. S. Farrow, timber-merchant, Diss, Norfolk, states to Mr. Withers, that 'It has always been a custom with me when I wanted a mild, tender piece of oak for any purpose, to look out for a slow-growing tree to cut it out of; and, on the contrary, when hard wood was wanted, to take the fast-growing tree, one which, before being felled, was in full and rapid growth, and I have ever found the latter much the most durable wood.' Two specimens of oak communicated by Mr. Farrow, No. 1, of a tree reared close to the rick-yard of the farm, and by the side of a ditch into which ran a great deal of moisture from the yard.

Andrew Knight, F.R.S., on this important subject is, that the toughest and most durable oak timber is obtained from trees of vigorous, rapid growth. The property of quick growth, in some species of trees, however, is confined to their earlier stages; in others it is not developed until they have stood several years in the soil, and in several the rate of annual increase of wood continues steady comparatively until the trees attain full maturity.

The locust-tree (*Robinia pseudo-acacia*), for instance, will outstrip the oak in the first ten years of their growth by a rate of increase at least double that of the latter, but afterwards the oak will gain upon the locust,

This tree grew rapidly, and, contained, when taken down, one hundred and sixty cubic feet of timber. The tree from which No. 2 was cut grew in the same field, and believed to have been planted at the same time. This tree grew well, but not in any degree so fast as the other, and contained about ninety cubic feet of timber. The age of the trees was estimated at one hundred and twenty years growth. These specimens were forwarded by Mr. Withers to Professor Barlow, for examination as to their comparative strength, and the following interesting results were obtained:—

No. 1.—Fast Grown Oak, Manured.

Specific gravity.	Weight when deflected the piece 1-30th of its length.	Broken with	Comparative strength.
972	606lbs.	999lbs.	1561lbs.

No. 2.—Slow Grown Oak, Natural Soil.

835	439lbs.	943lbs.	1473.

The strength of the fast-grown oak timber is, therefore, in this instance, superior to that of slower growth, as 15 to 14 nearly.

On these facts Mr. Withers observes, that 'the tree, which had no support but the natural soil, produced ninety feet of timber in one hundred and twenty years; the other, whose roots were continually nourished by manure, made one hundred and sixty feet in the same period, being a difference of seventy feet. The manured tree made, on an average, one foot one-third of timber in each year. Estimating, therefore, according to that rate of increase, this tree was, fifty years ago, of equal size, and of greater value, to the unmanured tree at the time it was cut down. Now, if we reckon the value of the timber at only 8*l.* a load, and allow compound interest for the fifty years, the difference of value between the manured and unmanured tree amounts to upwards of 165*l.* This,' continues Mr. Withers, 'is the amount of profit arising upon one tree; let a calculation, founded upon such data, be applied to the millions of acres which might be covered with forest-trees; and then let land-owners and statesmen reflect, whether *our own country* does not afford ample and profitable employment for all the "surplus agricultural labourers."' The cost of trenching and manuring, according to Mr. Withers' own experience, is stated to be as follows:—

Planted in April, 1824.	*l.*	*s.*	*d.*
Twenty loads of marl, at 1*s.* 3*d.*	1	5	0
Twenty ditto muck, at 5*s.*	5	0	0
Ploughing land	1	10	0
Trees, carriage, and planting	7	10	0
Total cost per acre	15	5	0

The results afforded to Mr. Withers by the above preparation of the soil, and by subsequent culture of the surface of the soil, were such as to be perfectly conclusive in favour of trenching and manuring to *holing* in unprepared soils. Now making every reasonable deduction for the uncertainty of the two oaks last alluded to having been reared under the same circumstances in every particular, which influences and governs the growth and progress to perfection of forest trees, (as already mentioned in Chapter II.,) except that of the supply of liquid manure to the tree No. 1, and making a similar deduction for the uncertainty of obtaining manure, and also that of the comparative rate of increase of timber between trees planted in the mode Mr. Withers recommends, or by the cheaper mode of holing, after the first twenty or thirty years of their growth, there are evidently advantages left sufficient to warrant the adoption of this mode of planting all soils of the nature mentioned at p. 39, whether on private estates or in the royal forests. In either case a certain sum can only be afforded, and it is then to be considered whether that sum had better be employed on a limited space of land annually, by which a speedier return of profit will be obtained, and the ultimate object, that of a stronger and more valuable quality of timber reared to perfection in a shorter period of time, or by covering a larger space of land with plants which will give inferior returns in a much longer extended period of growth.

and its rate of progress will continue superior. The silver fir increases comparatively at a much inferior rate to the larch and other fast-growing trees, for ten or more years, but in general it passes all these trees in height and in circumference by the thirtieth or fortieth years of its growth.

The comparative rate of increase annually of the following forest-trees is, in the average of cases, nearly in the following order:

Poplar,	for the first	50	years of growth.
Bedford willow	do.	25	ditto.
Birch	do.	20	ditto.
Larch	do.	60	ditto.
Sycamore	do.	50	ditto.
Pine	do.	60	ditto.
Silver fir,	after the first	30	ditto.
Alder	do.	25	ditto.
Locust	do.	15	ditto.

Trees of slower growth, but more equal in the rate of annual increase throughout their progress, are

Elm, ash, beech, sweet chestnut, oak.

On comparing a variety of measurements made of different trees on the same soil, and also of these in soils of different natures, the increase of the oak to that of the larch, at sixty-five years of growth, proved to be as 6 to 3.6 nearly. The silver fir stood to these in the proportions of 8 to 6 and of 8 to 3.6 *.

When a tree has attained to full maturity, or to as large a size as the nature of the soil and situation are capable of inducing, the annual production of shoots from the extremities of the top branches is scarcely perceptible. When these begin to decay, and the tree gives indications of soon becoming what is called *stag headed*, the profitable increase of timber has ceased in that tree, and it no longer occupies the ground profitably. The most profitable stage of growth, however, at which a tree may be taken, must be determined by the state of the market and the demand for particular produce. The only certain rule is, to ascertain the annual increase of timber in the tree, and determine thereby whether the value of that increase be equal to the annual interest of the sum the tree would bring, if felled, in addition to the charges of the land it occupies.

The following statement of the increase of trees at seventeen years of growth in the climate of Devonshire, on a porous soil, prepared by trenching, and planted in the most judicious manner, according to instructions by the Duke of Bedford, will show the comparative value of different species of forest-trees, as regards their property of affording early produce on a soil of the nature mentioned.

	Girt or Circumference at Two Feet from the Root. In.	Girt or Circumference at Seven Feet from the Root. In.
Popla	41	37
Larch	37	32¼
Pine	32¼	25¼
English elm	32	26
Silver fir	28¼	25
Spruce	27	22
Chestnut	27	22

* Well-authenticated facts relative to the comparative rate of increase of wood in the different species of forest-trees are much wanted. Without such facts, ascertained by careful and minute consideration of all circumstances influencing the growth of the trees, as soil, local climate, age, and culture, unerring or scientific principles cannot be obtained to guide the practical planter.

	Girt or Circumference at Two Feet from the Root. In.	Girt or Circumference at Seven Feet from the Root. In.
Birch	25	20
Sycamore	24	20
Beech	23	21
Oak	23	13
Ash	20	17

The heights of the trees were in full proportion to the girth, and the measurements are an average of the dimensions of six trees of each of the species respectively; there were numerous instances of individual trees exceeding any of the above in girth and length *.

Comparing the above with the former order of the rate of annual increase, the silver fir is found to be much lower in the rate of early produce in the first instance, but the genial climate in which the trees mentioned in the latter statement were cultivated will readily account for the discrepancy. In the higher grounds of Blair Adam before referred to, the silver fir is of slower growth than any of the trees mentioned in its early stages, but after that overtops them to a considerable height. The sweet chestnut, in the soil and local climate which thus rear the silver fir ultimately to such a high superiority, stands at the lowest point on the scale, while, in the more southern latitude and lower elevation, the chestnut takes precedence of the birch, sycamore, beech, oak, and ash. Local circumstances connected with soil, climate, and culture interfere with the idea of drawing general conclusions from these facts to be considered as data to guide the practical planter in every case; but to the valuer of plantations, which have only reached to their first stages of growth, these facts are of more extensive application, as showing the importance of estimating justly the effects of these agents in the progressive or annual rate of produce of timber in different species of forest trees.

The present value of a plantation is that which the market will afford for its produce at the time the valuation is made.

Prospective value is that to which the trees will attain at a remote period, or that to which they may arrive at full maturity, according to their respective species, and best fit the purposes for which they are most esteemed.

When a plantation is only of a few years growth, the value of the produce is too insignificant to be estimated, and the growth of the trees is often then so undeterminate as to render it difficult to calculate the ultimate results in this case; and when property is to be transferred, the cost of planting and the rent of the land occupied, with the sum of compound interest on the amount of these, must be taken as a just valuation.

When trees have reached to eight years of growth, their value is so small as to be below estimating; they will, however, by this time afford certain evidences on which to found calculations of their ultimate produce and value. Until trees have attained to a full timber size, the valuation of a plantation ought to proceed on the principle of prospective value. This includes, first, the number of years the trees will require to arrive at full maturity; secondly, the marketable value of the trees when at that perfection of growth; thirdly, the value of the periodical thinnings and of underwood. From the total amount of these sums must be deducted compound interest for the period the trees require to attain maturity; the remainder will represent the present transferable value of the plantation.

Thus on three and a quarter statute acres of a sandy soil, worth from five to twelve shillings per acre per annum when under pasturage, larch had

* Communicated by Mr. John Forester, at Endsleigh, Devonshire, from the Duke of Bedford's plantations.

been planted in 1810, and in 1826 it was desired to ascertain the prospective value of the plantation for 1851 *.

The trees amounted to 3311, of which 1000 were fit for fuel only, and required to be removed for the benefit of the healthy trees. The periodical thinnings being estimated every five years, this plantation would afford in

	Trees.	s.	d.	£	s.	d.
1831, thinnings	600 worth	0	10 each	25	0	0
1836,	560	1	6	42	0	0
1841,	504	2	6	63	0	0
1846,	212	6	0	63	12	0
Underwood cut at three periods, including 1000 stunted trees, fit only for fuel				6	0	0
				119	12	0

Timber Trees standing in 1851.

Largest sized trees 68, containing, on an average, each 30 feet of timber, at 1*s.* per foot				102	0	0
Second size	238 worth	10*s.*	0*d.*	119	0	0
Third size	129 do.	6*s.*	3*d.*	40	0	0
Total value of periodical thinnings, and of standing timber in 1851				380	12	0

Deductions.

Deductions for present payment.

	£.	s.			£.	s.	d.
Discount on	3	0	value of cuttings in	9 years	1	1	4
Ditto	3	0	ditto	9	1	1	4
Ditto	25	0	for thinnings in	5	5	8	3
Ditto	42	0	ditto	10	16	4	4
Ditto	63	0	ditto	15	32	14	0
Ditto	63	12	ditto	20	39	16	8
					96	5	11

Therefore prospective value as before	380	12	0
Deductions as above	96	5	11
Present or transferable value of the above plantation	284	6	1

From these details it will appear that an intimate knowledge of the habits of growth of the different species of forest-trees, and of the influence of soil and local climate on their periodical increase of timber, is absolutely required in the business of valuing plantations prospectively.

In settlements and divisions of landed property an accurate knowledge of the prospective value of all the plantations under full grown timber on the estates, is doubtless of great importance. The question of the comparative advantages and disadvantages of the occupation of land by forest-trees, and by corn and herbage, is one about which there has been much difference of opinion. There are those who contend that the former is

* The plantation in question formed a part of an extensive wood. From various causes, as the attacks of vermin, and the neglect of judicious culture, in suffering the natural produce of the soil to injure the young trees, and allowing trees of a more vigorous growth to injure those of a weaker, and partly also, from many of the plants having had an originally weak constitution, the failures had been considerable, but where the trees had escaped the effects of these evils, they had made good progress, and afforded evidence of future value as above detailed.

most advantageous, and others again argue, that for every purpose of private and public advantage, the latter is immeasurably superior. The truth lies between; for the fact is, neither of the two can profitably exist without the aid of the other, and the question becomes then narrowed to that of the proportions in which each should stand to the other. This point, however, has already been discussed as far as the limits of these pages permit, and it may be further only necessary to add, that the produce of timber in the United Kingdoms is very far from being sufficient to meet the demand for it. From a report of a select committee of the House of Lords, relative to the timber trade, made in 1820, it appears that the average quantity of foreign timber and deals imported into Great Britain during the four preceding years, amounted to 322,069 loads; the duty alone on which, in the last year of that average, 1819, amounted to 1,019,311*l.* 18*s.* 1½*d.* The statements of extraordinary profits from woodlands must be considered rather of a local than of a general interest; that of Lord Barham's chestnut plantation in Kent, which at nine years growth afforded a produce for hop-poles, which sold for 104*l.* per acre; a plantation of larch, for the same purpose, but on a soil not worth more than from 6*s.* to 7*s.* per acre, for cultivation, produced at the rate of 91*l.* per acre*. Of the willow, oak, &c. numerous instances of the like great profits might be adduced.

As a general estimate of the profits arising from forest-planting may not be uninteresting, the opinions of three professional planters of considerable experience on the subject are here mentioned.

Mr. Pontey of Huddersfield, the author of several esteemed treatises on planting, states, that from careful calculations of what might be reasonably expected from an acre of land suitable in itself, tolerably favourably situated, and in every respect well managed as a plantation of larch, the result is, a net profit—after paying for the rent of the land and every ordinary expense—of much nearer five than four hundred pounds in forty-two years.

Mr. Monteath, the well known author of the *Planter's Guide*, estimates the entire cost of planting, after the establishment of a nursery, at 22*s.* to 30*s.* per acre, with that of enclosing in large clusters, at about 10*s.* The periodical returns from an acre of larch only, after payment of the expenses of cutting, he calculates at from 5*l.* to 7*l.* at the expiration of the first ten years;

at least	£25	ditto second ditto.
	£300	at forty years growth.

And assuming the average rent and annual charges on an acre of light sand adapted to the growth of larch to be 12*s.*, the amount of profit and loss will stand as follows:

	£.	s.	d.
Enclosing and planting	2	0	0
Compound interest at five per cent. during ten years	1	12	6
Charges at 12*s.* per annum, with compound interest at five per cent. for ten years	7	11	0
	11	3	6
Deduct the medium value of the first thinnings; *i. e.* 5 to 7	6	0	0
Balance	5	3	6

* Kent Report, p. 146.

	£.	s.	d.
Compound interest, at five per cent. on balance for ten years	3	4	6
Annual charges, with compound interest during ditto	7	11	0
	15	19	0
Value of thinnings at twenty years growth	25	0	0
Profit per acre	9	1	0

Thus, according to this estimate, doubling the capital, with compound interest, in twenty years, besides leaving timber standing on the ground, which in twenty years more is calculated to be worth 300*l.*

Mr. George Sinclair, F.L.S., calculates, that the thinnings on an acre of land, of the value of from 5*s.* to 10*s.* per acre, planted with a mixed proportion of larch, beech, pines, hazel, birch, and oak—the latter with a view to the growth of navy timber, will, at the end of ten or fifteen years, according to local circumstances, repay the average expense of planting, rent, and management during that period, together with compound interest at five per cent.; and he estimates the clear profits of the future falls as follows:

In thirteen years, or at twenty-three years growth £24 10 0 per acre.
In thirteen years, or at thirty-six years growth 39 0 0 do.

And after that period a triennial profit of about 12*l.* per acre, until the oak left standing may be supposed fit for the naval yards, and worth at the present prices, 264*l.*, which leaves a balance superior in the proportion of 300 to 7 to the fee simple of the land*. But let it be remembered, that these calculations are all founded on the supposition of judicious planting and subsequent culture.

M. Chaptal† estimates the forests or woodlands of France to occupy about sixteen millions nine hundred and four thousand acres, or about one-seventh of the whole productive land of that kingdom. According to M. Herbin de Halle, there are of forest lands belonging to

	Acres.
The State	2,802,652
Crown	164,565
Princes of the Royal Family	479,348
Public Bodies	4,834,284
Private Individuals	8,623,555

The produce is estimated at five millions three hundred and forty-seven thousand pounds sterling, or about from six shillings and fourpence to seven shillings and fourpence per acre. Compared to this of woodland, the production of arable land is estimated at ten shillings, and grass land is placed on a level with that under the vine, *viz.* thirty-three shillings and eightpence an acre‡.

* These calculations were made at the same time by the three individuals mentioned, but unknown to each other; and as the results agree in all material points, except as regards the cost of planting in the second statement, which is very low, the general conclusion receives much weight.—*Prospectus of British Forest Planting*, 1826.

† *Journal des Forêts, tome premier. A Paris*, 1829.

‡ 'Les *prés* sont placés sur la même ligne, malgré le proverbe populaire qui dit que la vigne rachéte le pré.'—*Ibid.*

The royal forests of Britain occupy about 125,000 acres of land *; but of these the greater portion are subject to claims of various sorts for common of pasture, turbary, &c. There are 32,768 acres of forest-land enclosed and planted principally with oak, and with other trees where the soil is not adapted to oak. Of these 13,700 acres may be laid open when

* A Return, showing the number of acres in each of the Royal Forests, distinguishing the open commonable lands, and the lands appropriated to the growth of timber, in each forest; also, the number of acres of other lands, the property of the Crown, appropriated to the like purpose.

Name of the Forest.	Contents.	Open commonable Lands.	Lands appropriated for the growth of Timber.	Remarks.
	Acres.	Acres.	Acres.	
New Forest, in the county of Southampton	66,678	60,678	6,000	Subject to rights of common, the inclosed lands to be thrown open when the trees are past danger of deer or cattle, when an equal quantity may be inclosed out of the waste in lieu of what shall be restored to common.
Dean Forest, in the county of Gloucester	21,473	10,473	11,000	
Woolmer Forest, in the county of Southampton	5,949	4,249	1,700	
Waltham Forest, in the county of Essex	3,278	3,278		Subject to rights of common.
Alice Holt Forest, in the county of Southampton	1,892		1,892	The property of the Crown in fee.
Bere Forest, in the same county	1,417		1,417	
Salcey Forest, in the county of Northampton	1,285		1,285	
Windsor Forest, in the county of Berks	4,402		4,402	
Delamere Forest, in the county of Chester	4,641		4,641	
Parkhurst Forest, in the county of Southampton	900		900	
Whittlewood Forest, in the county of Northampton	4,500	1,122	3,378	517 *a.* 3 *r.* 31 *p.*, the property of the Crown in fee remainder, subject to rights of common; the inclosed lands in this and in Whichwood Forest consist partly of coppices, which are by law thrown open to deer and cattle at the end of 7 or 9 years from the time when first inclosed, and at which period the young trees are not past danger of deer and cattle, and are, in consequence, in a great measure, destroyed.
Whichwood Forest, in the county of Oxford	3,709	1,808	1,841	Subject to rights of common.
Other Lands appropriated for the growth of Navy Timber.				
Freehold lands in New Forest, in the county of Southampton			974	
Do. in and adjoining Dean Forest, in the county of Gloucester			3,708	
Do. do. Woolmer Forest, in the county of Southampton			183	
Do. do. Bere Forest, in the same county			132	
Woodlands at Eltham, Gillingham, &c. in the county of Kent			1,000	
Parcels of the Crown Estate at Chopwell, in the county of Durham			896	
Uninclosed Lands, arising partly from inclosures thrown open, and partly from woods of spontaneous growth, which are so stocked with trees as to be reckoned in the quantity of productive timber, estimated at about			7,500	
Lands now appropriated for the growth of Timber			52,850	

An

the trees are past danger of deer or cattle; and an equal number of acres to those thus laid open, may be enclosed and planted. The remaining 14,068 acres belong to the crown in fee, and will always be kept enclosed. There are 6211 acres of other freehold land belonging to the crown, which are also appropriated to the growth of timber, making in all 38,979 acres, the whole of which have been enclosed and planted within the last twenty years. In New and Dean forests, Hainault forest, Whittlewood forest, and Wychwood forest, there are open woods or coppices of considerable extent, containing trees of all descriptions, from ship timber down to saplings; but the number of acres so covered, or the number of trees occupying the surface, appear to be unknown.

The soil of the royal forests of Britain contain almost every variety of soil,—deep strong clay, rich deep loam, light loam on freestone gravel, bog, &c. The quantities of these different soils should be estimated. It is quite true that a field of ten acres may contain two or three different varieties of soil; but that is no substantial reason for not classifying the quantities on which to found a practical plan of management, so as to obtain the largest and speediest return of produce of the best quality, and that every portion of the land be occupied to the best advantage. Without an estimate of the spaces of the different soils, no accurate calculation can possibly be made of the produce the lands in question ought to and would afford under the most judicious culture; and consequently there is no check whatever to the practical management, but that of vague opinion.

As the most judicious, because the most profitable and certain in the result of obtaining the largest quantity of timber of the best quality in the shortest space of time, on a given space of land, the preparation of the soil for the reception of the plants by paring and burning the surface, afterwards trenching, and manuring when possible, and taking from the soil thus prepared an ameliorating fallow crop the season before planting, has been urged at pages 22, 27, and 39, as a general principle of culture for the soils of the nature specified. But if this mode of culture be therefore so superior as it is proved to be for planting lands under ordinary freehold tenure, how much more beneficial, or rather essential, must the adoption of it be in cases such as of those belonging to the crown, where the rights of common render it imperative to open the fences of the young plantations to stock or to sheep and deer in seven or nine years from the period of planting. The trees so cultivated will in that period be comparatively out of danger, and the ultimate object, that of timber of the best quality the soil is capable of rearing, secured. But besides these advantages, that of affording profitable employment to labourers out of work, in the parishes adjoining the lands in question, and at a season of the year when labour is most scarce, cannot but add powerfully to the reasons, sufficient of themselves, already offered on this head; besides the valuable example for imitation by the public which the Government would, in this important branch of rural economy, afford, and by it encourage those

An account of the quantity of land, cultivated and waste, in the British Dominions, including Scotland and Ireland, and the British Isles, according to the evidence of Mr. William Cowling, before the Emigration Committee, in 1827.

	Cultivated acres.	Uncultivated acres.	Unprofitable acres.	Total.
England . . .	25,632,000	3,454,000	3,256,400	32,342,400
Wales . . .	3,117,300	530,000	1,105,000	4,752,000
Scotland . . .	5,265,000	5,950,000	8,523,930	19,738,930
Ireland . . .	12,125,280	4,900,000	2,416,664	19,441,944
British Islands .	383,690	166,000	569,469	1,119,159
	46,522,970	15,000,000	15,871,463	77,394,433

who may possess waste or unproductive land to plant it, for a present benefit to the unemployed labourer, and as an accumulating capital for the younger branches of his family and posterity, as well as for the general good of his country.

The following statements will shew that the cost of preparing the different soils of the nature and properties described at pages 48, 49, and 50 of this Essay, and numbered 3, 4, 5, 6, for planting forest-trees in the best manner, that is to say, by paring and burning the coarse surface, trenching, draining, and manuring when expedient, and afterwards taking a green fallow, or ameliorating esculent crop as a precursor to the forest-tree plants, will be repaid by a judicious choice and culture of the kind of crop best adapted to the soil, and the produce of which is in a greater local request. It may be perhaps unnecessary to observe here, that the nature of different varieties of soil, comprehending their texture, chemical properties, the nature of the subsoil or mineral stratum on which they are incumbent, and their local climate and site, have all a great and active influence in determining the probable cost of the culture of the crops best adapted to be raised or cultivated upon them.

The local demand for the produce of particular species of husbandry crops have also a considerable influence on the comparative marketable value of these crops: hence it is impracticable to make a perfectly clear comparative estimate of value of different crops in the present case applicable to every different soil, unless those different circumstances alluded to under which each is placed were accurately known; but which, under ordinary circumstances, may be readily ascertained in the locality. The potato, Swedish turnip, cabbage, carrots, mangel worzel, khol rabi, tares, or vetches, &c., have each a superior local value, according to circumstances, besides that of their absolute or intrinsic value generally, as crops in husbandry. We may take the first-mentioned crop, therefore, as an example, its culture, comparative value as a fallow-crop, and the marketable value of its produce being, perhaps, more generally understood than that of the others. The soil is, taken of a second-rate quality, worth a rent of from fifteen to twenty shillings per acre.

	£.	s.	d.			
Paring and burning	1	16	0			
Trenching	4	0	0			
Draining or grubbing up	0	15	0			
Potato sets or seed, 16 bushels at 1s. 6d.	1	4	0			
Planting, ditto	0	16	0			
Hoeing and earthing up	0	16	0			
Reaping	1	10	0			
				£10	17	0
Produce						
6 tons of potatoes from a virgin soil, prepared by paring, burning, and trenching, at 44s.				13	4	0
Balance remaining				2	7	0

after preparing the soil in the best manner for planting, to go towards paying the purchase of plants and planting, as in the case of lands belonging to the crown, or, in other cases, towards the charges of rent, interest of capital laid out in fencing, payment of tithes, taxes, and other public imposts.

The above mode of preparing the soil would afford seventy-three days work an acre to labourers, at two shillings a day, chiefly in that portion of the year when labour is least in demand, viz., from the middle of September until April. Were fifty acres set apart every year on an average from each of the royal forests, and planted according to the plan now recommended, there being twelve royal forests situated in the counties of Southampton, Gloucester, Essex, Northampton, Berks, Chester, Oxford, Durham, and Kent, labour or work alike profitable to the unemployed and to the country would thus be given to six hundred men in the parishes and neighbourhood in which such lands are situated. The profitable results, as regards the attainment of the principal object in view, viz., timber of the best quality the soils employed are capable of affording, and that in the largest quantity on a given space of land, and in the shortest period of time, have already been discussed and shewn to follow the mode of culture described.

There is stated to be but one-sixteenth part of the timber used at the royal yards supplied by the extensive forests of the crown, the other fifteen-sixteenths having to be purchased from private estates, and from abroad. There is good reason to believe the planting and rearing of oak and of hard wood in general have not kept pace in England with the consumption of that article. The policy of depending on foreign countries for an article of such paramount importance as that of timber for naval and civil architecture, need not be discussed in these pages. But let us consider, however, whether the forests abroad are always to remain unexhausted for our demands, or the supply of our wants herein, while the neglect of planting continues;—we believe not; and that other countries will, at no very distant period, be in the condition that the North American states now are, as regards the supply of timber from their natural forests. That condition is described by an accurate observer, A. H. Hillhouse, a citizen of the United States, and the translator of Michaux's 'North American Sylva.' His words are, 'Though three-fourths of our soil (North America) are still veiled from the eye of day by primeval forests, the best materials for building are nearly exhausted. With all the projected improvements in our internal navigation, whence shall we procure supplies of timber fifty years hence for the continuance of our marine? The most urgent motives call imperiously upon government to provide a seasonable remedy for the evil: from a government like ours, which is a faithful expression of the public will, and which has no concern but the prosperity and honour of the nation, and from which prospective wisdom is reasonably demanded.'

It is observed by Mr. Loudon, in his Encyclopædia of Gardening, that in planting, as in every other branch of culture, extraordinary profit is attended by extraordinary production, which soon sinks the market value of the article; and also, that in a commercial, free, and highly taxed country, whenever any article attains a very high price, substitutes are found at home, or imported from abroad, so that no particular crop should be considered the best to cultivate without exception, nor extraordinary profits calculated prospectively on any crop whatever.

This opinion, however just, as applied to annual or biennial crops, is but slightly applicable to forest planting, and, indeed, not at all as regards the planting of waste or inferior soils, because, as before stated, the value of a crop of timber or of a forest plantation depends not alone on the relative or positive worth of the timber itself, as is the case with the kinds of crops alluded to, but also greatly on the circumstances of improving the climate and the soil of the adjoining lands, fitting them for the growth of

the more valuable husbandry crops, and the rearing and fattening of the more valuable domestic animals, which, without the aids that judicious forest-planting confers, would be withheld, and the land continue waste and unprofitable to the owner and to the nation.

The high perfection to which some individual trees of the different species have attained, is an object of much interest to the profitable planter of forest-trees as well as to all; for who does not derive pleasure of the highest order from the contemplation of woodland scenery? The limits of these pages admit but of a few short notices on this point.

The oak which was felled in April, 1791, in the park of Sir John Rushout, Bart., at Northwich, in Worcestershire, and judged to be about three hundred years old, and perfectly sound and fine timber, measured

	Feet.
In circumference, or girt, at five feet from the ground	21
Smallest girt	18
Length to the branches	30
Solid contents of the body	634
Estimated timber in the arms	200
Cubic feet of timber	834

The celebrated Fairlop oak, in Hainault Forest, Essex, is stated to have measured at three feet from the ground about thirty-six feet in circumference, and the extremities of the branches gave a circle of three hundred feet.

In Welbeck Park an oak is mentioned as one hundred and eleven feet in height, seventy feet up to the branches, and the circumference at the bottom twenty-one feet.

In Holt Forest, near Farnham, an oak in 1759 girted thirty-four feet at seven feet from the ground; in 1778, or in nineteen years, it had increased only half an inch.

At Oakley, in Bedfordshire, the seat of the Marquis of Tavistock, there is an oak now in perfect health, which contains about five hundred and twenty-seven cubic feet of timber, and the branches overspread a space of five thousand eight hundred and fifty superficial feet of ground.

Mr. Rookes, in his account of the oaks of Welbeck, mentions that an oak cut down in Birchland, had the letters I. R. more than a foot within the tree, and about a foot from the centre. It was supposed to be two hundred and ninety-two years old. It was perfectly sound, and measured about twelve feet in circumference.

The oaks in Woburn Park have already been alluded to as being trees of remarkably fine growth. There is one situated in the park, to the east of the Abbey, which measures ninety feet in height, the main stem of which is fifty feet, and head above the forks forty feet. This tree contains four hundred and ninety-two cubic feet of timber. The circumference at four feet from the ground is fifteen feet two inches.

There is another fine oak, in perfect health, which contains six hundred and sixty-six cubic feet of timber, on the west of the Abbey. The circumference near the ground is thirty feet, and the height to the boughs sixty-six feet. Four of these oaks measures two thousand and sixty-eight cubic feet of timber, after deducting one-eighth, the allowance for the bark. The variety of oak in this park is chiefly of that called the foot-stalked oak, *Quercus robur pedunculata.*

The elm may be placed next to the oak for utility and ornament. The wych elm is the most hardy. There is one mentioned by Evelyn in Sir Walter Bagot's Park, in Staffordshire, which measured forty yards in

length, and at the stool seventeen feet in diameter. The weight was estimated at ninety-seven tons.

The chestnut (Castanea vesca) may dispute the order of precedence with the elm, but that it is less hardy, and requires a milder climate, and more genial soil. On the banks of the Tamar, in Cornwall, there are some of the finest specimens of this tree. A very remarkable tree of this kind in England is at Tortworth, in Gloucestershire. A figure of it is given in the Gentleman's Magazine for 1766, p. 321. The age of this tree is supposed to be upwards of one thousand years. In 1791 it measured forty-four feet four inches in circumference. The soil in which it grows is described as being a soft loamy clay.

The finest tree on record of the beech appears to be that in Woburn Park, situated on a rising ground south of the Abbey, in a fine grove of that species of tree. The height of the tree at this period is one hundred feet. It has a clear and nearly equally cylindrical stem of the height of fifty feet, and the top, which is of the most graceful proportion in every respect, occupies fifty feet in height. The solid contents are four hundred feet. The soil in which this remarkable tree grows has already been described at p. 48.

Of the larch (Pinus larix), the finest specimens have been produced in the extensive woods of the Duke of Athol, at Dunkeld, in Perthshire. One tree of fifty years of age measured eighty-six feet and a half in height, and contained eighty-two feet of solid wood. There are instances of the larch attaining to upwards of one hundred feet in height, and of twelve feet in circumference.

The specimens of the silver fir (Pinus picea) at Blair Adam before mentioned are remarkable for size and symmetry; but the finest specimen, perhaps, in Britain grows in Woburn Park. The height of this tree is one hundred and ten feet, and the circumference at four feet from the ground, ten feet six inches; the solid contents or cubic feet of timber contained in it being three hundred and seventy-five feet. The age of the tree is about one hundred and ten years, and the average increase of height has, therefore, been exactly one foot every year, and the periodical produce of timber upwards of three, or nearly three and a half, cubic feet per annum. This appears to be the largest periodical increase of timber, continued for so many years, that is recorded.

Three black Italian poplars, planted by the present Duke of Bedford in 1806, are now of twenty-three years growth, and measure as follows:—

		Feet.	Inches.	Solid Contents.
No. 1.	Height	31	0	60 feet.
	Circumference or girth	6	7	
	The stem at fifteen feet ¼ girt,		19¼ in.	
	Ditto at sixteen feet above ¼,		13¼ in.	
No. 2.	Lost its top in a blast in 1828.			
	Measures—Height	23	0	45 feet.
	One-fourth girt	16¼	0	
No. 3.	Height	26	0	46 feet.
	One-fourth girt	0	16	

These trees were planted on a light soil, but well prepared by trenching.

The products of plantations have already been incidentally mentioned. The terms used by practical men to denote these products are not the same in all places, but frequently the same term is used in different counties to mean different products, and sometimes a term used in one place is totally unknown in another. As in legal instruments, relative to the transfer or holding of woodlands, the misunderstanding of these terms has

not unfrequently been the cause of serious inconvenience, it may be of use, therefore, to enumerate these names and synonyms.

Butt-end.—That portion of the stem of a tree which is situated nearest to the root.

Bush, in gardening and planting, applies exclusively to every perennial ligneous plant (mostly with several stems from its root), which in its natural state seldom attains to a timber size, *e.g.* having a stem *girting* six inches. We understand currant-bush, gooseberry-bush, rose-bush, holly-bush, laurel-bush, &c., but never oak, elm, or ash-bush, &c. The limits between a shrub or bush and a tree cannot be more precisely defined than by the girt or diameter of the stem, under ordinary circumstances of culture, never attaining to, or exceeding the above dimensions.

Bavins.—House-faggots, bound with two withers or weefs, chiefly used by bakers for the oven.

Binders.—Long pliant shoots of hazel, ash, &c., which have pliancy and length enough for binding down newly-plashed hedges, making close fences round rabbit-warrens, sheep-folds, hurdles, and binding faggots.

Bole.—The stem, trunk, or body of a tree, after it has attained to upwards of eight inches in diameter, or to that size which constitutes timber. Vide *Timber.*

Cane, Smart-hoops.—Shoots of the hazel, six feet in length; they are cleft for hoops, and are used by sugar-refiners for their earthen pots; also for salmon kits, small tubs, and other purposes of the cooper.

Cion, scion.—Properly a shoot one or two years old, or a cutting of a branch of that age for the purpose of grafting. Used sometimes to denote the shoots of a coppice stool. (Worlidge.)

Coopers' ware.—The lower ends of ash poles cut from six to eighteen feet long, according to the length of the shoot. They are cleft for the use of the cooper, waggon-tilts, &c.

Dead woods.—The same as *kiln-faggots*, which see.

Edders, Roders.—The same as *binders*, which see.

House-faggots.—The long branches of the hop and fence poles. The tops of hedge-stakes, coopers' ware, &c., bound with one *wither* or *wef.* Vide *Bavins.*

Kiln-faggots.—The lowest product of a plantation, being made of the brushings of the wood previous to the commencement of cutting the copse, and are made of brambles, dead-wood in the stubs, and refuse of plants on the surface of the ground; used for burning lime, bricks, &c.

Girt, girth, of the *bole*—Is sometimes understood as the circumference of the stem, but more generally as the fourth part of the circumference or side of the square of the stem. Gilpin (in 'Forest Scenery,' vol. i. p. 59 and p. 141) uses it in the former sense, when he says, 'at Wimly, near Hitchin Priory, Herts, a chestnut-tree, in 1789, girted somewhat more than fourteen yards.' He could not mean the tree to square forty-two feet in the side. Grose also appears to use the term *girt* in the same sense, when speaking of the limb of a chestnut-tree at Fortworth, in Gloucestershire:—'One limb measured twenty-eight feet and a half in girt, five feet above the crown.'—*Philosophical Account*, p. 176. Of the same tree he says the stem 'girted fifty-one feet at six feet from the ground.' And Professor Martin quotes from an inscription placed under an etching of it, stating that 'the tree measures nineteen yards in *circumference*,' which sufficiently proves 'the sense in which the word 'girt' is understood by the above. The word girt is doubtless derived from girth, *quasi*, to gird or encompass, notwithstanding its general acceptation is to denote the fourth part only of the circumference, or side of the stem when squared.

Log.—The trunk or body of a timber-tree prepared for the sawyer.

Maiden-plant.—A young tree raised from seed, in opposition to one produced from an old root or stub.

Moot, in Devonshire, is the same with stool in other counties. Vide *Stool.*

Nascent stem.—The development of the stem of a seedling plant, just previous to the exhibition of the first leaves.

Poles.—Shoots from coppice-stools on the stems of young trees of various lengths, according to the purpose for which they are wanted; those for hops should be from ten to eighteen feet long.

Red-hearted.—A discoloration of the central point or heart-wood of a tree, most frequently arising from bad management in the early culture of the tree, by neglecting to prevent or remove every cause of *stunting* the growth in the earliest stages of culture. An ungenial soil produces this defect likewise.

Sapling.—A young tree under six inches diameter at four feet from the ground; in some places it is used to denote a young tree raised immediately from the seed, which is then termed a maiden-tree; in others it is considered a young tree, the produce of a coppice-stool, old root, or stub, and, by a few, a long young tree, the produce of either.

Sears, or low faggots.—Made similar to bavins (which see), but longer, and generally bound with three withs: used for sheltering farm-yards, hovels, and for various other purposes.

Fall cutting.—A term used to denote the period of cutting a copse, which varies from twelve to eighteen and thirty years, according to the soil or produce of the coppice, and the judgment of the proprietor.

Shaky—shakes.—The fissures, cracks, or longitudinal openings often found in the timber of trees which have suffered from injudicious culture and an ungenial soil, vide p. 73.

Shoot.—Indifferently used for the young, lateral branch of a stem, or that of a coppice-stool or stub.

Sprig of wood.—In some instances understood as the branches of a tree. Vide *act.*

Standard.—The shoots of a coppice stool, selected from those cut down as underwood to remain for large poles or timber-trees.

Slivery.—Small, straight shoots of large ash, &c., cleft into hoops for the purposes of the cooper. Vide *Cane and Coopers' ware.*

Stem.—The body of a tree in all its stages of growth, from a seedling to that of a full-grown tree. See *Bole.*

Stole.—The first stage of growth of a shoot emitted or sent out from the sides of a root or stub or coppice-stool. See *Tiller.*

Stool.—The root of a tree which has been left in the ground, the produce of another tree, or shoot for saplings, underwood, &c.

Stub.—See *Stool.*

Sucker.—Properly the young plants sent up by creeping-rooted trees, as in the poplar, elm, &c. These suckers are oftentimes very troublesome, under the circumstance of their often appearing in lawns, or grass fields near a mansion. The term sucker is also applied in some places, to denote the side shoots from a stool or stub. See *Stool.*

Tap-root.—The first root produced by the seed of a tree, which descends at first perpendicularly into the earth, and supports the plant until the proper leaves are produced, which, in their turn, assist in the production of fibres or proper roots.

Tellow.—See *Tiller.*

Tielar.—See *Tiller.*

Tilar.—See *Tiller.*

Tiller, or *Tellar*, a shoot selected for its superior strength and healthy habit from those produced by a coppice-stool to stand for a timber-tree, or for maiden bark, if an oak, to stand for the space of two or three falls.

Timber.—When the wood of a stem or branch of any species of plant attains to the dimensions of 24 inches in circumference, or upwards of eight inches in diameter, it is termed *timber*. Those plants whose wood never, or but seldom, attains to the size now mentioned, come under the denomination of shrubs or bushes, poles, &c. Hence the popular distinction between *tree* and *shrub* or *bush*.

Here it may be proper to state the usual mode of determining the quantity of timber in trees. The customary method of measuring timber is by *girting* the piece in the middle, *i.e.* from the *butt-end* or root to the top, where it terminates, at 24 inches in circumference. The mean between these two points affords the nearest average of the circumference or diameter. The fourth of this circumference, squared and multiplied by the length, gives the contents. Thus suppose a stem or bole measures $75\frac{4}{10}$ inches in circumference, or 24 inches in diameter, and 15 feet in length: *then* $75\frac{4}{10} \div 4 = 18\frac{8}{10} \times 18\frac{8}{10} = 2$ft. 5.5 × length 15ft. = 36ft. 9.3 in. But by taking $\frac{1}{5}$ of the circumference and twice the length, the result is more accurate, thus—$75\frac{4}{10} \div 5 = 15$; then 15 × 15 × 30ft. = 46ft. 10.6. But it need hardly be remarked that neither the fourth nor the fifth of the circumference can be used to determine accurately the cubic contents, although in common practice the first is considered sufficiently so. The nearest approach to the truth of the contents is to multiply the square of the circumference of the stem by its length, and that multiplied by .07958 will give the number representing the solid contents, thus—$75\frac{4}{10}$ × .079574 × 15ft. = 47 1.5. Or square the diameter thus,—24 × 24 × .7854 × 15 = 47 1.5. But whatever mode of measurement and calculation be adopted, an allowance must be made for the thickness of the bark. Different species of trees differ much in this respect, and the age of individuals of the same species differ likewise, according to the age of the tree. It is customary in the oak, elm, and trees having a rough bark, to deduct at the rate of one inch for every foot of quarter girt, that is, if the circumference is four feet, the quarter girt is one foot or 12 inches, and the allowance for the bark will reduce it to 11 inches. Less than one foot quarter girt down to six inches, the allowance is made at the same rate, and so for any increase above the example quoted. In ash, and other trees having a thin bark, the allowance is half an inch for every foot of quarter girt. In Scotland, according to Mr. Monteath, the rule is to allow for bark two inches in circumference from 12 to 24 inches; three inches in a circumference of from 24 to 36; from 36 to 48, four inches; from 48 to 72, five inches, and above 72 inches in circumference, to deduct six inches.

Trunk.—The body or stem of a forest-tree. See *Bole.*

Withers or *weefs.*—The pliant shoots of hazel, ash, willow, &c., for binding the spray and prunings of trees into faggots, brooms, &c. See *Binders.*

Chapter VIII.

Enumeration of the different species of Forest Trees.

In the following list the trees are arranged in the order in which they are supposed to stand in natural alliance with each other; but being a selection from the whole vegetable kingdom as regards one property, only that of producing timber in the climate of Great Britain, there will be found therefore great breaches in the natural connexion between many of the individuals comprising a list so formed; and on this account, and the want of space, as well as that the Linnean botanical descriptions are equally efficient in distinguishing one family of plants from every other, and different species of plants from each other, the Linnean descriptions only are given.

MAGNOLIACEÆ.

Polyandria Poly. Linn.

Eng. Name.	Bot. Name.
Cucumber-tree or	Magnólia.

Generic Character—*Calyx*, three-leaved; *petals*, nine; *capsule*, two-valved, imbricated; *seed*, berry, pendulous.

Time of sowing seed—as soon as it can be procured from abroad. Sow in pots filled with a mixture of loam and peat, and plunge them into an old hot-bed of tanner's bark. They may also be propagated by layers.

Uses—Veneering, the purposes of the turner, and those of timber in general for in-door works.

Species for Ornament, Shelter, or Underwood.

Magnolia.	Cucumber-tree.	Native of	Ft.
Umbrella-leaved	*tripétala*	N. Amer.	30
Bluish flowered	*acumináta*	——	25
Heart-leaved	*cordáta*	——	—
Great flowered	*grandiflora*	——	60-70
Long-leaved cucumber-tree	*auriculata*	——	20
Large-leaved	*macrophýlla*	——	30

Magnólia grandiflóra. Big laurel and large magnolia of America, and laurier tulipier of the French, is first seen in North Carolina, near the river Nuse, in the latitude of 35° 31′; and proceeding from this point, it is found in the maritime parts of the southern States and of the Floridas, and as far up the Mississippi as Natcher, 300 miles above New Orleans, which embraces an extent of 2000 miles. According to Michaux, the *magnólia grandiflóra* claims a place among the largest trees of the United States, as it sometimes reaches ninety feet in height and two or three in diameter, but its ordinary stature is from sixty to seventy feet. Its trunk is described as being commonly straight, and its summit nearly in the shape of a regular pyramid. The same author observes, that they who have seen this tree in its native soil, blooming with its large white fragrant flowers disposed amidst the rich foliage of the tree, agree in considering it one of the most beautiful productions of the vegetable kingdom. In Carolina it blossoms in May, and the seeds are ripe about the beginning of October. The wood is soft, and remarkable for its whiteness, which it preserves even after being seasoned; it is said to be easily wrought, and not subject to warp, but that it is not durable when exposed to the weather; for this reason the boards of the *magnólia grandiflóra* are used only in joinery in the interior of buildings. In its native climate it grows only in cool shady places, where the soil is composed of brown mould, and is loose, deep, and fertile. The seeds preserve their vegetative powers several months out of the ground. A single tree sometimes yields four hundred cones, each of which contains from 40 to 50 seeds. The most northern point which this tree passes the winter in the open air, is about Nantes, in lat. 47° 13′, but it begins to bear ripe fruit about Grenoble, in lat. 45°. In a garden near Philadelphia, Michæux saw a tree of this species, which bore uninjured the rigorous climate of this part of Pennsylvania, which is much more severe than that of Paris or London. In England the *magnólia grandiflóra* is more injured by being

planted in an ungenial soil than from the severity of the climate. The fact is, the soil should be that above described, but not an insulated portion, as is mostly the case in practice, by digging a hole and supplying it to the plant merely to that extent, whereas it should be general over a large extent of surface, so as to effect the atmosphere by its peculiar exhalations, thus acting on the leaves as well as on the roots. The *magnolia grandiflora* was introduced into England about 1731.

Magnólia gláuca.—This tree is found common in Lower Jersey, but is also found in latitude 45° 50′, near Cape Anne, in Massachussets, N. America. In the Carolinas and in Georgia it does not ordinarily exceed twenty or thirty feet, although it sometimes attains to forty feet in height. At New York it yields fruit at the height of five or six feet. The wood is not considered to be of any value in building. The flowers are flagrant, and the bark of the roots has an aromatic odour and a bitter taste. The country people in Lower Jersey drink an infusion of this bark in brandy as a remedy in rheumatic affections, and an infusion of the cones in whiskey is regarded by them also as a preventive against autumnal fevers. (Michaux, 11.) This tree appears to have been introduced into England in 1688.

Magnólia acumináta is common in all parts of the United States of America, where it is generally known under the name of the cucumber-tree. Its stature is similar to the magnolia grandiflora, rising to sixty or seventy feet, and sometimes even as high as ninety feet. It is found as far north as the 43rd degree of north latitude, near the celebrated cataract of the Niagara river. The inhabitants of the countries bordering on the Alleghanies gather the cones about midsummer, when they are half ripe, and steep them in whiskey; a glass or two of this liquor, which is extremely bitter, is a preservative against autumnal fevers: on this Michaux remarks, that though he does not deny the efficacy, the remedy has not been made sufficiently evident to induce any physician to attempt its verification. In its native soil, Michaux describes the trunk as perfectly straight, of an uniform size, and often destitute of branches for two-thirds of its length, the summit ample, and regularly shaped; the flowers are five to six inches diameter, of a bluish white, having a feeble odour, but as they are so large and are numerous, they have a fine effect in the midst of the super-foliage. The wood is soft, and like that of the poplar, is fine grained, and susceptible of a brilliant polish, but it is neither strong nor durable when exposed to the weather. In England this tree is perfectly hardy, and attains to a considerable size. Introduced into England in 1736.

Magnólia cordáta, heart-leaved cucumber-tree, in its native soil of the banks of the river Savannah in Upper Georgia, and those of the streams which traverse the back parts of South Carolina, attains to forty and fifty feet in height, and from twelve to fifteen inches in diameter. The leaves are from five to six inches in length, and from three to five in width; the flowers, which appear in April, are yellow, and are nearly four inches in diameter. The wood is of no determinate use, but the tree is very hardy and ornamental in parks. Introduced into England in 1801.

Magnólia tripétala, umbrella-tree, is found in soils deep and fertile in the northern parts of New York, and is common on some of the islands of the river Susquehanna. Near the great swamps of South Carolina and Georgia it is almost invariably accompanied by the magnolia grandiflora and swamp chestnut oak. It is of humbler growth than the magnolia grandiflora, seldom attaining to thirty or thirty-five feet in height, with a diameter of five or six inches. The leaves are eighteen or twenty inches long, and seven or eight broad; the flowers are white, and seven or eight inches in diameter. The fruit is four or five inches long and two inches in diameter. The wood is light and porous, and unfit for use. The tree is highly ornamental and very hardy. Introduced into England in 1752.

Magnólia auriculata, long-leaved cucumber-tree, is equally remarkable with the magnolia tripetala, for the beauty of its foliage and the size of its flowers, which are also of an agreeable odour, and is found, Michaux observes, only in a small tract far retired in the

country, at the distance of 300 miles from the sea, on a part of the Alleghany mountains. In its native soil it attains to forty or forty-five feet, and a diameter of twelve or fifteen inches. The leaves are of a light green colour, of a fine texture, eight or nine inches long, and from four to six inches broad; the base of the leaf is divided into rounded lobes, whence the name ear-leaved. The flowers are white, and from three to four inches diameter. The wood is light and spongy, and unfit for the purposes of the carpenter. The bark is stated to have an agreeable aromatic odour, and an infusion of it in ardent spirits is employed as an excellent sudorific in rheumatic affections. It is a hardy tree, and very ornamental for parks. Introduced into England in 1786:

Magnólia macrophy'lla, vel *Michauxii*, large-leaved cucumber-tree, is more remarkable for the superior size of its leaves and flowers than any other species of this genus. It resembles most the magnolia tripetala in its general habit of growth, and it is generally found growing in company with it. The leaves are sometimes thirty-five inches long, and nine or ten inches broad. The flowers are white, fragrant, and larger than those of any other species of magnolia, being sometimes eight or nine inches in diameter; the buds are compressed, instead of being rounded at the end, as in the magnolia tripetala, and they are covered with a soft and silvery down: this circumstance affords a ready distinction between these species at that season when the flowers and leaves are absent. The wood is of an inferior quality. The tree is highly ornamental. In its native soil, according to Michaux, it grows to the height of thirty-five feet. Introduced into England in 1800.

The other species of magnolia or cucumber-tree in the gardens of England, come at present, or as far as experience of their habits in this climate indicates, exclusively under the head of ornamental plants or shrubs, and consequently they are omitted in this enumeration.

TULIP-TREE. LIRIODENDRON.

Calyx, three-leaved; *petals*, six; *seeds*, into a strobule, or cone.

Time of sowing seed—spring. *Soil*, light earth, to be shaded from the heat of the mid-day sun.

Uses—The wood is esteemed for its lightness and durability, and in the western states of North America it is used as a substitute, in building, for the wood of the pine. The inner bark of the branches and root is used as a substitute for the Peruvian in remittent and intermittent fevers. It delights in a light rich loamy soil. It has been known to measure 22 feet in circumference, and to rise to 120 feet in height. Introduced into England in 1688.

Species for Ornament, Shelter, or Underwood.

Common.....*tulipifera*..N. Amer. ..60
Var. Entire lvd. .*integrifólia* —— —

TILIACEÆ.

Polyandria Polygynia. Linn.

Trees of the habits and general appearance of the common Lime or Linden-tree.

LIME-TREE. TILIA.

Calyx, five-parted; *corolla*, five-petaled; *capsule*, coriaceous, globular, five-celled, and five-valved, opening at the base; *seed*, one or two in each cell, roundish, covered with a coriaceous globular-shaped capsule, which has five valves, five cells, and opening at the base.

Time of sowing seed—Autumn, in a shady border of moist, light soil; but the usual mode of propagation is by layers. *Soil*—in almost any kind of soil, if moderately damp.

Uses—The wood is light, delicately white, and of an uniform texture, useful for some domestic purposes, and for those of the carver. Gibbon's inimitable carvings of flowers, dead game, &c., were of this wood, Br. Fl., vol. iii. p. 18. The bark of this, and probably of other species of lime, makes the Russian mats called *bast*. As an ornamental tree, the lime is esteemed for the fragrance of its flowers, of which bees are very fond.

Mr. Boutcher says, at eleven years old the plants will be twenty feet high; and at sixteen years old, from thirty to thirty-five feet high. The common yellow twigged lime, called also linden tree, and smooth-leaved lime, was formerly more than now a great favourite with planters. Whether it be properly a native of Britain, seems

to be uncertain, but that it has been long naturalized in this country is certain. A lime tree is described by Dr. Turner as growing near Colchester, which must have been cultivated in England before 1562. Du Hamel states that the French, in the reign of Louis XIV., growing tired of the horse chestnut, adopted this tree; and Sir James Smith, in his English Flora, observes that it generally composes the avenues about the residences of the French as well as English gentry of that date, and that Fenelon, in conformity to this taste, decorates with 'flowery lime trees' his enchanted isle of Calypso. The fragrance of the flowers are well known; they constitute an useful ingredient in *pot-pourri*. Bees are attracted, in great numbers, to collect honey from the flowers, in the season of flowering. The wood is smooth, delicately white, and uniform in its texture (vide p. 11, fig. *p*.); it is observed to be little subject to the attacks of insects. The beautiful carvings of Gibbon, before mentioned, which are dispersed about the kingdom, as in the choir of St. Paul's, Trinity College Library, at Cambridge, the Duke of Devonshire's, Chatsworth, &c. are stated to be of this wood*. It is also used by the turner in manufacturing light bowls, and boxes for the apothecary. The bark contains much mucilage; by maceration it separates into thin tough layers, which are manufactured into garden-mats, sometimes termed *bast mats*. These are well known to form a considerable part of the exports from Russia.

The broad-leaved lime, *tilia grandifolia*, attains to as large a size as the common linden; the young wood of the shoots is often red. The leaves have rather longer foot-stalks, the *ribs* and *veins* minutely hairy, or curiously fringed above the origin of each; all the under side of the leaves is finely downy, but not glaucous, as in the *tilia parvifolia* and American limes. This species, or, perhaps, variety, has been found in woods and hedges at Whitstable, Surrey; on the banks of the Mole, near Boxhill, by Mr. E. Forster; near Streatham Wells, Surrey, by Mr. Dubois; and in Stoken-church woods by Mr. Bicheno, but apparently planted*. This is stated to be the wild lime of Switzerland and the south of Europe, as the common species, *europæa*, is of the north. The *coral lime* is so nearly allied to this species, as to be considered by some botanists a variety only.

The small-leaved lime, *tilia parvifolia*, flowers about a month later than the last-mentioned tree. It is supposed to be the only true native species of lime. It is to be found frequent in Essex, Sussex, and Lincolnshire, and elsewhere, according to Ray. The leaves are much smaller than those of the above, being about two inches broad, dark green, and quite smooth above, glaucous underneath, with brown hairy tufts at the origin of each of their principal veins, as well as broad hairy blotches frequently found scattered over their surface. The comparative value of the timber of these last-mentioned species has not yet been determined. Among the American species of this tree the *smooth* or *bass-wood*, *tilia Americana*, is distinguished. Michaux informs us that he found it most abundant in Gennesse, which borders on Lake Erie and Ontario. In some districts between Batavia and New Amsterdam, it constitutes two-thirds, and sometimes the whole of the forests. It attains to the largest size in a loose deep fertile soil. It is found 80 feet in height, and 4 feet in diameter. The wood is white and tender, and is, in some places, substituted for that of the tulip-tree for the panels of carriage bodies, and the seats of Windsor chairs.

The white lime, *tilia alba*, is chiefly found on the banks of the Ohio, Susquehanna, and those of the streams which empty into them. The same authority observes, that it rarely exceeds 40 feet in height, and 12 or 18 inches in diameter.

The downy lime, *tilia pubescens*, is a native of the Floridas, and Southern parts of the United States. It resembles the American lime tree more than the preceding. The leaves are very downy on their under side, obliquely truncated at the base, and edged with fewer teeth than the other

* Evelyn's Sylva.

* Engl. Fl., vol. iii. p. 19.

species. The flowers are also more numerous, and produced in larger bunches. The wood has not been proved as to its properties. All these trees are ornamental, and afford a cool shade in summer.

Timber or Forest Species.

LIME-TREE.	TILIA.	Native of	Ft.
Red-twigged Lime-tree	*rúbra*	Britain	50
Yellow	*europæa*	Britain	50
Var. Jagged-lvd.	*laciniáta*	Britain	30
White	*álba*	Europe	30
Downy-leaved	*pubéscens*	Carolina	20
Smooth	*grandifólia*	Britain	—
Var. coral-twigged	*corallina*	Britain	—
Broad-leaved	*glábra*	N. Amer.	30
Silvery-leaved	*argéntea*	Hungary	—

Species for Ornament, &c.

Long-petaled	*petioláris*	——	—

ACERINEÆ.—*Nat. Sys.*

Polygamia Monœcia. Linn.

Eng. Name.	Bot. Name.
MAPLE-TREE.	ACER.

Calyx, five-cleft; *corolla*, five-petaled; *germs*, two or three superior; *style*, simple; *seed*, single, roundish shaped, its capsule terminated by a wing-like membrane.

Time of sowing—as soon as possible after the seeds are ripe: some are of opinion that the seed should be preserved in dry sand until February or the beginning of March. *Soil*—This genus will thrive in coarse land, but the European species attains the greatest size in a deep, moist soil, free of stagnant moisture; those which are natives of America require a drier soil than the above.

Uses—The wood of the common maple or sycamore is considered superior to that of the beech for the uses of the turner, in making domestic utensils, and also for the uses of the joiner for inlaying. It is sometimes also used by musical instrument-makers; but it is chiefly valued for its property of quick growth as coppice or underwood.

Timber or Forest Species.

Polygamia Monœcia. Linn.

MAPLE-TREE.	ACER.	Native of	Ft.
Common	*campéstre*	Britain	35
Italian	*ópalus*	Italy	50
Norway	*platanoides*	Europe	50
Sycamore	*pseúdo-plátanus* (in Scotland, Plane-tree.)	Britain	50
Sugar*	*saccharinum*	N. Amer.	40—70

Species for Ornament, Shelter, or Underwood

Striped-leaved, or variegated	*pseúdo-plátanus variegátum,*	Britain	
Blunt-leaved	*obtúsum*	——	
Sir C. Wager's	*dasycárpum*	N. Amer.	
Bastard	*hýbridum*	Hybrid	
Cut-leaved	*platanòides laciniátum*	Europe	
Mountain	*montánum*	N. Amer.	8
Ash-leaved	*negúndo fraxinifólium*	——	30—40
Scarlet-leaved	*rùbrum*	——	
Tartarian	*tatáricum*	Tartary	

* In America this tree is called rock maple, hard maple as well as sugar maple. It is no where more abundant than between the 46th and 43d degrees of latitude, which comprise Canada. According to Dr. Rush, there are *ten millions of acres* in the northern parts of the states of New York and Pennsylvania, which contain these trees in the proportion of thirty to an acre. The wood is rejected in civil and naval architecture, but the wood of old trees is esteemed for inlaying mahogany, and is termed *bird's-eye maple*. To obtain the finest effect caused by the inflection of the medullary rays, which produce spots resembling the eye of birds, the log should be sawn in a direction as nearly as possible parallel to the concentric circles. The ashes are rich in alkaline principle; and it is asserted that four-fifths of the potash exported to Europe from Boston and New York, are furnished by the sugar maple. The sugar maple begins to be found wild in Canada, near the 48th degree of latitude, a little north of Lake St. John, and, as above stated, is most abundant between the 46th and 43rd degree. It is very rare in the lower parts of Virginia, the Carolinas, and Georgia. It flourishes best where the soil, though rich, is cold and humid, and situated on elevated declivities. But the great value of the sugar maple in America consists in the superior quantity of sugar afforded by the sap of the tree. In February or March, while the ground is covered with snow, and the cold is still intense, the tree is bored to the depth of half an inch within the wood, with an auger three-quarters of an inch in diameter, and in an obliquely ascending direction, on the south side of the tree, and at about eighteen or twenty inches from the ground. There are two holes made in this manner, four or five inches apart. Tubes of eight or ten inches long, and three-quarters of an inch in diameter, made of elder or sumac, having a portion of their length laid open, are inserted into them to conduct the sap into troughs, which are made to contain two or three gallons. The sap continues to flow or yield sugar, Michaux observes, for six weeks, after which it declines in quantity and quality. Four gallons of sap are considered to give one pound of sugar, and from two to four pounds is mentioned as the produce of a tree. Sheds are erected near the trees, where the persons who conduct the process of boiling the sap and extracting the sugar, are sheltered. Three persons are allowed to be sufficient to tend 250 trees, which give 1000 lbs. of sugar. It is stated that eighty millions of pounds of sugar are consumed in the United States, of which fifty millions are imported, ten millions furnished by the sugar cane of Louisiana, and ten millions from the maple. Of the other maples above enumerated, their comparative value, as timber trees, has not been sufficiently proved to allow of separate notices in the limits of these pages.

Montpelier.....*monspessulánum* France
Oblong-leaved ...*oblóngum*...Nepaul
Striped-barked...*striátum* ...N. Amer.
Opalus-leaved....*opalifólium*. S. Europe
Hungarian.....*obtusátum*..Hungary
Cretan .....*créticum* ...Levant
Evergreen.....*heterophýllum* ——
Bearded .....*barbátum* ..N. Amer.
Black Sugar.....*nigrum* .... ——
Palmate .....*palmátum*..China
Large-leaved....*macrophýllum*. Columbia
Iberian .....*ibéricum* .....Iberia
Round-leaved ...*circinnátum*.. Columbia

HIPPOCASTANEÆ. *Nat. Sys.*

Eng. Name. Bot. Name.
HORSE-CHESTNUT. ÆSCULUS.

Heptandria Monogynia. Linn.

Calyx, one-leaved, five-toothed, ventricose; *corolla*, five-petaled, irregularly-coloured, inserted into the *calyx*; *capsule*, three-celled; *seeds*, two, sub-globular, enclosed in a roundish-shaped capsule, containing three cells, and opening with three valves to emit the seeds.

The seeds should be preserved in dry sand till spring, and sown early in that season; but should the soil be dry, and free from the attacks of vermin, it is advantageous to sow as soon as the seeds are ripe. *Soil*—The horse-chestnut grows to the largest size in a sandy loam, but will grow in almost any kind of soil.

Uses—for fuel; but chiefly planted for the beauty of its flowers and its habit of growth. The common horse-chestnut, though a native of the northern parts of Asia, is never injured by cold in Britain, into which it was introduced about 1689, or, according to some, in 1683. It is sufficiently known for the beauty of its form when in full foliage and in flower, particularly when planted singly or in rounded groups, in lawns, and parks. For avenues it is less desirable, or where it overshadows roads, as the leaves fall early in the autumn. The species enumerated below, natives of North America, are all more or less ornamental, and deserving of a station in the margins of forest plantations. The comparative value of their timber has not yet been proved.

Timber or Forest Species.

HORSE-CHESTNUT. ÆSCULUS.
Common.....*hippocastánum* Asia....40

Species for Ornament, &c.

HORSE-CHESNUT. ÆSCULUS. Native of Ft.
Golden-striped...*hippocastánum, fol. aur.*
Silver-striped ... ——, *fol. arg.*
Double-flowered. *flóre pléno* .. ——
Flesh-coloured...*cárnea* ..... ——
Ohio .....*ohioénsis* ...Nor.Amer.

Eng. Name. Bot. Name.
BUCKE-EYE-TREE. PAVIA.

Pale-flowered ....*pállida* .... N. Amer.
Smooth-leaved...*glábra*..... ——
Long-spiked.....*macrostáchya* ——
Variegated-flowered *hýbrida*... ——
Dwarf.....*discolor* .... ——
Neglected .....*neglécta* .... ——
Red-flowered....*rúbra* ..... ——10—8
Yellow-flowered..*fláva* ..... —— 40

RHAMNEÁCEÆ. *Nat. Sys.*

CHRIST'S-THORN. ZIZYPHUS.

Pentandria Monogynia. Linn.

Calyx, tubular; the scales of the *corolla* are inserted in the calyx, and support the stamina. *Seed*, a two-celled nut, covered by a berry.

Time of sowing seeds—Autumn, in pots. *Soil*—Sandy loam. *Uses*—Chiefly planted for the singularity of its spines or thorns.

Species for Ornament, &c.

Common.....*paliúrus*..S.Europe. Introduced in 1640.

HOLLY. ILEX.

Tetandria Tetragynia. Linn.

Calyx, four-toothed; *corolla*, wheel-shaped; *style*, wanting; *seeds*, four, solitary, horny, oblong, rounded on one side, cornered on the other, enclosed in a roundish four-celled berry.

Time of sowing—The berries should be placed under ground in a pot or large tub for one year, and then sown in the autumn upon a bed of sandy loam. *Soil*—The holly flourishes best in a dry, sandy soil, but will grow on land of almost any description. *Uses*—for the purposes of the turner, the inlayer, mill-wright, and engineer. The tree is in great esteem for the ornament of its evergreen foliage. Bird-lime is manufactured from its bark. The common holly, besides being a native of England, is also found wild in many parts of Europe, Japan, Cochinchina, North America, &c. As an evergreen fence it is superior to every other plant. It bears clipping

well, and is never injured by the severest frost. When reared to the height of two feet, by transplanting from the seed bed to a rich sandy soil, the plants may be removed, and planted as a hedge with perfect safety on well trenched and manured ground; this removes the only objection to the holly for fences, which is its slow growth. We have moved plants four feet in height successfully, and thus made a comparatively impenetrable live-fence the first season.

The *Carolina*, or *American Holly*, attains to a great height in its native soil. Its wood is held in great estimation, but in this respect it is not considered superior to that of our native species.

Species for Ornament, &c.

HOLLY.	ILEX.		
Common	*aquifólium*	Brit.	20—30
Var. Various-lvd.	*heterophýlla*	—	
„ Thick-leaved	*crassifólia*	—	
„ Hedgehog	*férox*	—	
„ Striped do.	*echináta*	—	
„ Yellow-berried	*fláva*	—	
„ White-margined	*álba margináta*	—	
„ Gold-edged	*áurea margináta*		
„ Painted	*média pícta*	—	
„ Spineless	*senéscens*	—	
„ Milk-maid	*lactária*	—	
„ Carolina	*opáca*	N. Amer.	30

JUGLÁNDEÆ. *Nat. Syst.*

Monœcia Polyandria. Linn.

Eng. Name.	Bot. Name.
WALNUT-TREE.	JUGLANS.

MALE FLOWER—ament or catkin, imbricated—*calyx*, scaly; *corolla*, six-parted; *filaments*, many, seven or more. FEMALE FLOWER—*calyx*, of four divisions, superior; *corolla*, with four divisions; *styles*, two; *seed*, a nut with four divisions, marked by intervening membranes, substance of the seed grooved—it is covered by a corticated, dry, oval-shaped, two-valved drupe.

Time of sowing—Preserve the nuts until February in their outer covering, after which they may be sown. *Soil*—A rich loamy soil is that in which the walnut attains the largest size, but it will succeed in very light, siliceous, sandy soils, as well as in clayey ones. *Uses*—The wood of the walnut is highly valued for many purposes, such as gun-stocks, domestic utensils, furniture, wainscoting, &c. Among the American Walnuts, the black, *Juglans nigra*, is considered to have wood of a more valuable quality than the common walnut, but this latter has a decided superiority in the excellence of its fruit and properties of its oil. The black walnut is considered to be one of the largest trees of America. On the banks of the Ohio, and on the islands of that river, Michaux states that he has found them from sixty to seventy feet in height and four feet in diameter, and that it is not rare to find them six or seven feet. Of the Hiccories, the Pignut, or Cárya *porcína*, is perhaps the most valuable, not for its fruit, but for its wood, being comparatively the best. The comparative value of these trees has not yet been proved in England—hitherto they have been looked upon as merely ornamental park trees, or subjects for botanical investigation. Some of them, however, rank among the largest trees in North America, where, according to Michaux, the general opinion there formed of the wood of the different species cut out from the natural forests is, that it is of great weight, strength, and tenacity, but liable to a speedy decay when exposed to damp, heat, and to worms

Forest or Timber Species.

Filaments of the female flower many.

WALNUT-TREE,	JUGLANS.	Native of	Ft.
Common	*régia*	Persia	50
Var. Dble.-fruited	*reg. máxima*	—	—
„ Late-fruited	*reg. serótina*	—	30
Black	*nígra*	N. Amer.	—
Shell-bark	*cinérea*	—	
Ash-leaved	*fraxinifólia*	—	
Winged-fruited	*pterocárpa*	Caucasus	
Hiccory-nut	*cárya*	—	
Filaments of the female flower		—	4 to 6
White hickery, or Shagback	*álba*	—	
Olive-fruited or Pecannut	*olivæfórmis*	—	60*
Flat-fruited	*compréssa*	—	
Smooth-leaved	*glábra*	—	
Narrow-leaved	*angustifólia*	—	
Bitter nut	*amára*	—	70 to 80
Pig nut	*porcína*	—	

CONNARACEÆ. *Nat. Syst.*

Polygamia Monœcia. Linn.

Eng. Name.	Bot. Name.
TREE OF HEAVEN.	AILANTHUS.

MALE FLOWER—*calyx*, one-leafed, five-

* Michaux gives the character of the fruit as the finest flavoured of all the American walnuts, and to be more delicate than the European species. He advises it to be grafted on the common walnut.

parted, very small; *corolla*, five petals, acute, convolute at the base; *stamina*, filaments ten, compressed, the length of the corolla.

FEMALE FLOWER—*calyx*, as in the male; *corolla*, as in the male; pistil, germs 3—5; *styles* lateral; *capsules*, compressed; *seeds*, solitary; lens-shaped. Bisexual flowers as in the above.

		Native of	Ft.
Tall Ailanthus, or Tree of Heaven	*glandulósus*	China	50

Though a native of China, this tree bears our winters without injury. It grows fast, and attains to a great height; there are many trees of this kind in England from thirty to forty feet and more in height. It is a handsome tree, and the wood is said to be hard, heavy, and glossy, like satin, and susceptible of the finest polish. It is well worthy the attention of those who have it in their power to benefit themselves and the nation, by determining the comparative value of the different species of forest-trees. Some remarkable fine specimens of this and of comparatively rare American forest-trees, are in the grounds of the Duke of Northumberland at Syon.

Time of sowing the seeds—As soon as they are received from abroad in boxes of light earth, or sand and peat, protected under glasses.

LEGUMINOSÆ. *Nat. Sys.*

GLEDITSCHIA, or SWEET LOCUST.

BISEXUAL FLOWER—*calyx*, four-cleft; *corolla*, four-petaled; *stamina*, six; *pistil*, one. MALE FLOWER—*calyx*, three-petaled; *stamina*, six. FEMALE FLOWER—*calyx*, five-leaved; *corolla*, five-petaled; *pistil*, one.

Seeds, solitary, roundish, hard, shining, enclosed in a legume or pod, which is broad, much flatted, and divided by several transverse partitions.

Time of sowing the seed—Seeds procured from America, sow half an inch deep; they frequently remain two years in the ground before they vegetate. *Soil*—A sandy loam. *Uses*—This plant is valued for the beauty of its habit of growth. If planted in exposed situations, the branches are apt to be broken by the winds.

Polygamia Dioecia. Linn.

SWEET LOCUST. GLEDITSCHIA.		Native of	Ft.
Thr.-thorned acacia	*triacánthus*	N.A.	40 to 60
Var. Spineless	*inérmis*	——	30 to 40
Single-seeded, or water acacia	*monospérma*	——	
Strong-spined acacia	*hórrida*	China	

(*Subórdo, Papilionaceæ.*) *Nat. Sys.*

Eng. Name.	Bot. Name.
SOPHORA.	SOPHORA.

Decandria Monogamia. Linn.

Calyx, four-toothed; *corolla*, pea-flowered; *seed*, pod, long, slender, one-celled, numerous, forming prominent knobs on the surface of the pod.

Time of sowing seed—as soon as it can be procured; sow in pots filled with light earth. Plant in a sandy loam, and in a sheltered situation. *Use*—Valued for its handsome foliage and habit of growth.

SOPHORA.	SOPHORA.		
Japanese sophora	*japónica*	Japan	40

The wood of this tree, when fresh cut, emits an odour offensive to insects. In England we have seen it attain to upwards of 20 feet in height, with a proportionate diameter. Its pinnated leaves, which are smooth and of a beautiful green, give to the tree a graceful appearance. It is a native of Japan, and was introduced into England in 1753.

FURZE, WHIN, GORSE. ULEX.

Monadelphia Decandria.—Linn.

Calyx, of two ovate-oblong concave leaves, rather shorter than the keel; the upper with two small teeth, the lower with three; *corolla*, of five petals; standard, ovate-cloven; wings, oblong, rather shorter than the standard; keel, of two petals, straight, obtuse, cohering by their lower edges; filaments, in two sets, both united at the base; *anthers*, roundish, of two lobes; *germen*, oblong, nearly cylindrical, hairy; *legume*, or *seed-pod*, oblong, turgid, scarcely longer than the calyx of one cell, and two rigid elastic concave valves; *seeds*, from six to eight, polished, somewhat angular, slightly compressed, with a cloven tumid crest.

Species for Underwood, Fencing, &c.

FURZE. ULEX.		Native of	Ft.
European, or Common	*europæ'us*	Britain.	
Dwarf	*nánus*	——	
Provence	*provinciális*	S. Europe.	

Time of sowing the seed—as soon as ripe in the autumn, or in March. *Soil.*—Dry, sandy, and gravelly soils suit best the growth of furze. It does not

however grow well on very thin heath soil, nor on damp clays. In Cornwall the common sort (*ulex europæus*) attains to 8 feet in height. In Devonshire, according to Vancouver, this species is termed French furze, although we suspect the *ulex provincialis* is the species which ought to come under this name. In some places the *ulex nana* is called French furze. The botanical distinctions are as follow:—

The Common Furze, *Ulex Europæus.*
Branches, erect, somewhat villous; *calyx*, pubescent, teeth obsolete converging, bracteas densely downy, oval, loose.

French Furze, *Ulex Provinciális.*
Branches, erect, somewhat smooth; *calyx*, a little pubescent, nearly as long as the corolla, teeth lanceolate, distant, bracteas minute, compressed.

Dwarf Whin, or Furze, *Ulex nána.*
Branches, decumbent, hairy; teeth of the *calyx*, lanceolate, distant, and spreading; *bracteas*, minute, rounded, and close pressed.

From the above it is evident that the common furze and the French species are nearly allied; the dwarf furze has the leaves or spines shorter and closer, and the branches decumbent. These points of structure distinguish this species from the others at the first sight. Its value is estimated, in comparison to that of the common, as two to one inferior.

The common furze generally attains to its full size in four years, and it ought not to be cut more frequently. In local cases, as in the neighbourhood of potteries, Vancouver observes it makes a return of from 15*s.* to 20*s.* an acre annually. The wood is very hard, but never attains to a size available for the business of the carpenter. It is chiefly used for fuel, fences, and food for cows, horses, and sheep. On soils such as now alluded to, it makes a good fence, but requires peculiar management to prevent it becoming naked at the root. Sowing in three tiers on a bank is perhaps the best mode, as it allows of one to be kept low by the shears or bill, the second of higher growth, and the last to attain its natural stature. Respecting its merits as an article of fodder, a good deal has been written; as, for instance, by Duhamel in France, Evelyn in England, and Doctor Anderson in Scotland; and at this time, and for that purpose, as we are informed, it is cultivated successfully by Mr. Attwood of Birmingham. It requires to be chopped or bruised, as a preparative to its mastication. It would be valuable information to know the *comparative value* of the Whin to that of Lucern, Turnip, Red Clover, cultivated separately, or a combination of *Dáctylis glomeráta*, *Lólium perénne*, *Festúca duriúscula*, *Póa praténsis*, *Cynósurus cristátus*, *Lótus corniculátus*, *Phléum praténse*, *Trifólium répens*, *Trifólium minus*, *Medicágo lupulina*, and a small portion of *Achillea millefolium*. The produce of plants constituting the richest pasture plants, when combined on a furze soil, are proper to compare with the produce of furze, to ascertain the most profitable crop with which to occupy the soil in question, and this point has not yet been determined.

Eng. Name.	Bot. Name.
LABURNUM.	CYTISUS.

Calyx, labiate; *legume*, or *seed-pod*, tapering at the base; *seed*, kidney-shaped, compressed.

Time of sowing seed—March. *Soil*—This tree attains the greatest perfection on a sandy loam, but it may be planted in almost any kind of soil, except where stagnant moisture prevails. *Uses*—Although an ornamental tree, yet its wood or timber is valuable for various kinds of fancy wood-works, such as musical instruments, handles of knives, &c. The wood is very hard, takes a fine polish, and, when of sufficient size, may be manufactured into the most elegant kinds of furniture.

In the species here enumerated, the pods are one or two-jointed, joints globular.

Species for Timber as well as for Ornament, &c.

Monadelphia Decandria. Linn.

LABURNUM.	CYTISUS.	
Com. laburnum ..	*labúrnum* ..	Eur. .10—25
Scotch laburnum .	*alpínus*. . . .	

Robínia, or Locust-tree, False Acacia, &c.	Robínia *.

Calyx, one-leafed, four-cleft; *legume*, compressed, long, gibbous; *seed*, kidney-form.

Time of sowing the seed.—The end of March, on a bed of light earth. The

* So named by Linnæus in honour of J. Robin, a French botanist, who first introduced the tree into France from Canada, in the reign of Henry IV., about the year 1601.—Mich.

following spring transplant the seedlings in nursery rows about the end of March, the rows to be three feet apart, and the plants a foot and a half asunder in the rows. In one or at most two years they should be planted out where they are intended finally to remain. *Soil*—It will grow in almost any soil, but attains to most perfection in such as is light and sandy. *Uses*—The wood is hard and very durable. It is esteemed, in America, preferable to the best white oak for axle-trees of carriages, trenails for ships, posts for rail-fencing, and for withstanding the bad effects of moisture when fixed in damp ground. It is frequently substituted for box by the turners, for the manufacture of sugar-bowls, salt-cellars, candlesticks, forks, spoons, &c. It was cultivated in England in 1640, by Mr. John Tradescant, or nearly two hundred years ago. But the only satisfactory authenticated statements we can find of the greatest age of Locust trees now growing in England (with that of their produce of timber) does not exceed sixty years. A locust-tree, in the grounds of the late Charles Bloomfield, Esq., Bury St. Edmond's, of sixty years growth, in 1829, measured in height from forty to fifty feet, and the circumference at three feet from the ground six feet seven inches, the solid contents being fifty-four feet of timber*. The limits of these pages do not permit further details, except to observe that, owing to the brittle nature of the wood when young, the leading shoots of the stems, as well as the branches, are very liable to be broken by the wind, and probably it is from injuries of this kind that many trees are found unsound even before forty years of growth: great attention to early training or pruning appears to be required by the locust. The comparative strength as to fracture of its timber compared to that of oak, appears to be in favour of the former, according to Professor Barlow, fine English oak 1672 to locust 1867. The comparative value of the timber of the other different species of Robinia mentioned below, has not yet been ascertained: their value for ornament is well known.

* Withers MS. Correspondence.

Diadelphia Decandria. Linn.

ROBINIA.	ROBINIA.	Native of	Ft.
Locust-tree, or False Acacia	*pseudo acácia*	N.Am.	35-50
Clammy	*viscósa*	——	30-40
Spineless	*inérmis*	——	—
Long-leaved	*macrophýlla*	Siberia	—
Parasol	*umbraculifera*	——	—
Upright	*stricta*	——	—
Pendulous	*péndula*	——	—

Ornamental only.

Rose Acacia	*hispida*	Carolina	60
Purple	*purpúrea*	——	—
Smooth-branched	*rósea*	Carolina	—

Eng. Name.	Bot. Name.
KENTUCKY COFFEE-TREE, OR HARDY BONDUC.	GYMNOCLADUS.

Dioecia Decandria. Linn.

MALE FLOWER—*Calyx*, five-toothed; *corolla*, five petalled. FEMALE FLOWER—the same as the male; *stile*, one; *legumen*, one-celled; *seeds*, several, embedded in a pulp. Propagated by suckers from the root, as well as from seed.

Kentucky Coffee-tree *Canadensis* N.Amer. 40

There is only one species of this tree. In its native soil of that part of Genesee which borders on lake Ontario and lake Erie, and in the states of Kentucky and Tennessee, Michaux states it to attain to fifty or sixty feet in height, and that the stem is often destitute of branches for thirty feet, while the diameter seldom exceeds twelve or fifteen inches. In summer, when it is fully grown, it has a fine appearance. On young trees the leaves, which are doubly compound, are three feet long and twenty inches wide. The bark is very rough, and detaches itself in small vertical strips. The name of coffee was given to this tree by the early emigrants to Kentucky. The seeds appear to possess no culinary value. The wood is very compact and of a rosy hue, which fits it for the use of the cabinet-maker. Michaux observes that, like the locust, it exhibits almost nothing but heart-wood, for that six inches in diameter has only six lines of sap-wood. These qualities, he observes, recommend it for culture in the forests of the north and centre of Europe. It was introduced into England, in 1748, by Archibald Duke of Argyle, but its culture appears not to have extended beyond the garden.

AMYGDALINÆ. *Nat. Sys.*

Eng. Name.	Bot. Name.
ALMOND-TREE.	AMYGDALUS.

Icosandria Monogynia. Linn.

Calyx, five-cleft, inferior; *petals*, five; *seed*, a nut, oval-shaped, compressed, acute, with prominent sutures on each side, netted in four rows and dotted, enclosed in a villose or woolly drupe.

Time of sowing seed—Autumn; cover with light dry earth, three inches deep. *Soil*—A sandy loam, in a sheltered situation. *Uses*—Gay and ornamental flowers in the spring: the naked seed of the almond, properly so called, yields an essential oil, and, by trituration, forms an emulsion, or cooling beverage, much used.

The naked seed or almond of the *Amygdalus amara* affords an oil of similar properties to that of the *Amygdalus communis*, but the bitter principle contained in the farinaceous part of the seed is deleterious, containing prussic acid.

Species for Ornament, &c.

ALMOND-TREE.	AMYGDALUS.	Native of	Ft.
Sweet almond	*communis*	Barbary	18
Bitter almond	*amara*	——	——
Double blossomed	*flore pleno* (*Persica*)	Persia	——
Chinese	*cochinchinensis*	China	

POMÁCEÆ. *Nat. Sys.*

MESPILUS.	MESPILUS.

Icosandria Di-pentagynia. Linn.

Calyx, five-cleft; *petals*, five; *berry*, inferior; *seeds*, five, bone-like, enclosed in a globular berry.

Time of sowing the seed—autumn, or as soon as ripe. *Soil*—a rich loam; but it will succeed in any description of soil free from the extremes of moisture and dryness. *Uses*—for its ornamental habit of growth and its fruit.

Species for Ornament, &c.

MESPILUS.	MESPILUS.		
Medlar, common	*Germánica*	England	12
Var. Uprt. medlar	*stricta*	——	——
„ Dutch	*diffusa*	——	——
Quince-leaved mespilus	*tomentósa*		
Tansy-leaved hawthorn	*tanacetifólia*	Greece	12
Large-flowered mespilus	*grandiflóra*	S. Europe.	——

Eng. Name.	Bot. Name.
PEAR-TREE.	PYRUS.

Calyx, five-cleft; *petals*, five; *seeds*, several, oblong, blunt, accuminate at the base, convex on one side, flat on the other, enclosed in a pome or apple, fleshy, with five membranous cells.

Time of sowing the seed—Spring: preserve the seed during winter in dry sand. *Soil*—rich clayey loam, but also on gravelly and chalky soils on elevated, exposed situations. *Uses*—for underwood, ornamental blossoms and fruit: the white beam (pyrus aria), however, is considered by some to rank as a timber-tree; the wood, tough and hard, is sometimes used for axletrees, handles of tools, &c. The wood of the wild service-tree (torminalis) is likewise applied to the same purposes, and its fruit is frequently brought to market.

Species for Ornament, &c.

PEAR-TREE.	PYRUS.	Native of	Ft.
Arbutus-leaved	*arbutifol.*	Virginia	
Var. Red-fruited arbutus-leaved	*rúbra*	——	
„ White-fruited arbutus-leaved	*álba*	——	
„ Black-fruited arbutus-leaved	*nígra*	——	
Snowy	*nivális*	Austria.	
Wild pear-tree	*communis*	England	
Woolly-leaved	*pollvéria*	Germany	
Crab-tree	*málus*	Britain	
Chinese apple	*spectábilis*	China	
Siberian crab	*prunifólia*	Siberia	
Small-fruited crab	*baccáta*	——	
Sweet-scented crab	*coronária*	Virginia	
Narrow-lvd. crab	*angustifólia*.	N. Amer.	
Com. quince-tree	*cydónia*	Austria	
Willow-lvd. crab	*salicifólia*	Levant	
White beam-tree	*ária*	Britain	30
Swedish do.	*intermédia*	Sweden	
Wild service pear-tree	*torminális*	Eng.	30—40

AMELANCHIER.	AMELANCHIER.

Icosandria Pentagynia. Linn.

Snowy Amelanchier. *botrýapium*. N. Amer.

CRATÆGUS.

Calyx, five-cleft; *berry*, inferior; *seeds*, two, roundish, umbilicated, body somewhat long, distinct, cartilaginous.

Time of sowing seed—Autumn. *Soil*—will succeed in almost any kind of soil of intermediate quality as to moisture and dryness: the most ornamental and useful of the species are the vari-

eties of the common hawthorn (oxyacantha), the Glastonbury is remarkable for the season of the year in which it comes into flower, which is usually in January or February, and sometimes at Christmas, according to the state of the weather then, and of that during the previous summer and autumn. The wood of the common Hawthorn is hard and tough, and is esteemed for axle-trees, handles of tools, &c. When planted singly it not unfrequently rises to 20 or even 30 feet in height; and we have measured stems of individual trees of this species, varying from 3 to 7 feet in circumference. The merits of this and the interesting species and varieties mentioned below, for ornament in park scenery, come more properly for discussion under the second division of the subject of Planting, proposed in the introduction to this treatise: but though their value, in an economical point of view, has not yet been determined, their natural habits and growth offer matter well worthy the attention and investigation of the forest-planter, and they are therefore here enumerated. *Uses*—The common hawthorn, it is well known, is used for making quick or live fences. It is of great importance to have the plant strong and large before finally planting it in the hedge-row. This plant delights in a deep soil, and where it is not naturally such, its depth ought to be increased. When the plants or quicks are large, they produce a fence in a short space of time, and save much expense in weeding, nursing, and temporary fencing.

Species for Ornament, &c.

CRATÆGUS.		Native of	Ft.
Great American hawthorn	*cratægus coccínea*	N. Amer.	
Maple-leaved	*cordáta*	——	
Pear-leaved	*pyrifólia*	——	
Oval-leaved	*elliptica*	——	
Hollow-leaved	*glandulósa*	——	
Yellow-berried	*fláva*	——	
Gooseberry-leaved	*parvifólia*	——	
Great red-fruited	*punctáta*	——	
Var. Yellow-fruited	*áurea*	——	
Common cockspur	*crusgálli*	——	
Var. Pyracantha-leaved	*pyracanthifólia*	——	
„ Willow-leaved	*salicifólia*	——	
White-thorn	*oxyacántha*	Britain	
Var. Common	*vulgáris*	——	
Var. Great-fruited	*májor*	——	
„ Glastonbury	*præcox*	——	
„ Dbl.-flowered	*pléna*	——	
Yellow-berried	*áurea*	——	
Parsley-leaved	*azarólus*	S. Europe	
Elegant red	*élegans*	——	
Sweet-scented	*odoratíssima*	Crimea	
Woolly-fruited	*eriocárpa*	Britain	
Sloe-leaved	*prunélli fólia*	N. Amer.	
Cut-leaved	*dissécta*	Persia	
Comb-shaped	*pectináta*	——	
Frosted	*pruinósa*	——	
Crimson	*punícea*	Dahuria	
Black-berried	*melanocárpa*	Tauria	

OLEINÆ. *Nat. Sys.*

Eng. Name.	Bot. Name.
ASH-TREE.	FRAXINUS.

Polygamia Dioecia. Linn.

BISEXUAL. MALE FLOWER—*calyx*, none, or a four-parted perianth; *corolla*, none, or four petals; *stamina*, two; *pistil*, one; *capsule*, one-seeded, terminated by a spear-shaped membranous wing. FEMALE FLOWER—*calyx*, none, or a four-parted perianth; *corolla*, none, or four petals; *pistil*, one; *capsule* and *seed*, the same as in the bisexual flower.

Time of sowing the seed—Autumn, as soon as ripe, or dry the seed in a cool airy loft, and preserve them in sand during the winter; and then in April sow them on beds of fresh mellow soil; the plants will appear in the following spring; but if sown in the autumn as soon as ripe, most of the plants will appear in the same season.

Soil—Clayey loam brings the ash to the greatest perfection, but it will grow on every description of soil. Evelyn mentions an ash-tree of 132 feet in height, and Young, in his Irish Tour, states the length of an ash, at thirty-five years growth, to be 70 feet.

Uses—This wood is hard and tough, and much esteemed for implements of husbandry, and also for the purposes of the coach-maker, cooper, turner, &c. It makes a profitable kind of underwood, and may be cut every eight years for hoops, and every fourteen years for hop-poles, &c. It is said that the leaves, when eaten by cows, give the butter which is made of their milk a rank taste; butter, however, in the spring, and towards autumn, has frequently a rank taste, when the cows yielding it are completely out of the reach of leaves of any kind of forest-trees whatsoever.

When planted in hedge-rows, the ash is apt to impoverish the soil around it in a greater degree than most other trees. This tree is by many considered to stand next in value to the oak. It is mentioned as such by the oldest writers*. Where pollard trees are permitted, the ash makes one of the most profitable. Dr. Withering states, that a decoction of two drachms of the bark has been used to cure agues. The Manna Ash, *Fráxinus rotundifólia*, in England seldom attains to more than 20 feet in height; the leaflets are shorter, of a deeper green colour, and more deeply serrated on the margins than those of the common ash. It is a native of Italy, and is most abundant in Calabria, where it grows spontaneously on the lower parts of the mountains. This tree affords the well known medicinal laxative substance termed *manna*. It is obtained by making a horizontal incision in the stem of the tree towards the end of July. The fluid gum is received into cups formed of the leaves of the maple, and conducted into them by the foot-stalks of the leaf, or by straws inserted into the incisions. The manna continues to exude from the wounds of the bole for about a month after the incision is first made†. The comparative merits and value of the other foreign species of ash mentioned below, remain yet to be proved by the British forester; and we shall here, therefore, only observe, that the white ash of North America, among those enumerated below, is the only species that at present is considered to approximate to, and rival the common ash in value. In New Brunswick and Canada it most abounds, and is most multiplied in the United States, north of the river Hudson. Its most favourable sites are the banks of rivers and the edges and surrounding acclivities of swamps; it there sometimes attains to eighty feet in height.

* Vide Gentleman's Magazine, 1785; Hunter's Evelyn; Withering's Arrangement of British Plants; Pennant's Tour, 1772, p. 29; Gilpin's Forest Scenery, Vol. II., p. 280; Martyn's Ed. Miller's Gard. Dict.; Art. Fraxipus.

† See Trans. Royal Soc., vol. ix.

Timber or Forest Species.

ASH-TREE.	FRAXINUS.	Native of	Ft.
Common	*excélsior*	Britain	70
Entire-leaved	*simplicifólia*	——	30
White American	*americána*	N.Amer.	40
Var. Black do.	*pubéscens*	——	—
„ Red do.	*rúbra*	——	—

Species for Ornament, &c.

Weeping	*excel.péndula*	Britain	70
Horizontal	„ *horizontális*	——	
Erose-leaved	„ *erósa*	——	
Striped bark	„ *striáta*	——	30
Walnut-leaved	*juglandifólia*		
Aleppo	*lentiscifólia*	Aleppo	
Flowering	*órnus*	Italy	
Many-flowered	*floribúnda*	Nepaul	
Manna	*rotundifólia*	Italy	
Cloth-leaved	*pannósa*	N.Amer.	
Four-sided	*quadrangulàta*	——	
Flat-seeded	*platacárpa*	——	
Long-leaved	*longifólia*	——	
Red-veined	*rubicúnda*	——	
Green-branched	*víridis*	——	
Cinereous	*cinérea*	——	
Grey-branched	*álba*	——	
Richards'	*Richárdi*	——	
Sharp-leaved	*oxycárpa*		
Elder-leaved	*sambucifólia*	N.Amer.	
Silver-leaved	*argéntea*	Corsica	
Elliptic-leaved	*elliptica*	N. Amer.	
Oval-leaved	*ováta*	——	
Mexican	*mexicána*	Mexico	
Dotted-stalked	*epíptera*	N. Amer.	
Red-veined	*rubicúnda*	——	
Powdered	*pulverulénta*	——	
Mixed	*mixta*	——	
Expanded	*expánsa*	——	

ELÆAGNEÆ. *Nat. Sys.*

Eng. Name.	Bot. Name.
OLEASTER-TREE.	ELÆAGNUS.

Tetrandria Monogynia. Linn.

Calyx, four-cleft, bell-shaped; *corolla*, none; *drupe*, inferior; *seed*, a nut, oblong, obtuse.

Time of sowing seed—Autumn: may be sown in pots or propagated by layers. *Soil*—A sandy loam is what it affects most. *Uses*—It is admired for the fragrance of its foliage. The comparative value of its wood has not yet been proved.

Species for Ornament, &c.

OLEASTER-TREE.	ELÆAGNUS.	Native of	t.
Narrow-leaved	*angustifólia*	S. Europe	18

URTICEÆ. *Nat. Sys.*

Eng. Name.	Bot. Name.
MULBERRY-TREE.	MORUS.

Monœcia Tetrandria. Linn.

MALE FLOWER—*calyx*, four divisions; *corolla*, none. FEMALE FLOWER—*calyx*, four-leaved; *corolla*, none; *style*, two; *seed*, single, ovate, acute, covered by the calyx, which ripens into a large fleshy berry.

Time of sowing seed—March, in light earth, with gentle artificial heat; or propagate by layers. *Soil*—It flourishes best on a rich sandy loam; but it will thrive even on very sandy soils, if of proper depth. *Uses*—The black mulberry is chiefly cultivated for its fruit, and the white mulberry for its leaves, which are considered the best food for the silk-worm. It has been long ago recommended that, instead of pulling the leaves off singly for the food of the silk-worm, they should be shorn off, together with their young branches, by which the tree is much less injured.

Timber or Forest Species.

MULBERRY-TREE.	MORUS.		
Common	*nigra*	Italy	30
Red	*rúbra*	N.Amer.	—

Species for Ornament, &c.

White	*álba*	China	20
Paper	*papyrífera*	Japan	

LOTE or NETTLE-TREE.	CELTIS.

Polygamia Monœcia. Linn.

BISEXUAL FLOWER—*calyx*, five-parted; *corolla*, none; *stamina*, five; *styles*, two; *drupe*, one-seeded.

MALE FLOWER—*calyx*, six-parted; *corolla*, none; *stamina*, six; *seed*, a nut, roundish.

LOTE or NETTLE-TREE.	CELTIS.		
European Nettle-tree	*austrális*	S.Eu.	20to40
Eastern	*orientális*	Levant	—
American	*occidentális*	N.Am.	50
Willdenow's	*Willdenowiána*	China	—
Chinese	*sinénsis*	—	—
Tournefort's	*Tournefórtia*	Levant	—

Time of sowing the seed—March, or, if it can be procured in time, sow in the autumn, in a mixture of peat and loam, placed in pots or boxes, sheltered from the frost, and shaded in hot weather from the sun. These trees require protection for the first two years, or while young; afterwards they may be planted in any moderately exposed situation. The soil best adapted to them is a sandy loam.

Uses.—the wood of the European nettle-tree is considered to be one of the hardest; and Evelyn says, that in former times it was used for the manufacture of musical instruments. The American nettle-tree is similar in its foliage and general appearance to the European species; the branches of both are numerous and slender, and the limbs take their rise at a small distance from the ground, and grow in a horizontal or an inclined direction. Michaux observes, that the comparative value of the wood has not been proved in America, but that it is similar in properties to the former species. As yet those other species enumerated above are considered as merely ornamental.

Eng. Name.	Bot. Name.
ELM-TREE.	ULMUS.

Pentandria Digynia. Linn.

CALYX—five-cleft, inferior, permanent; *corolla*, none; *seed-vessel*, compressed, flat, one-seeded; *seed*, roundish, slightly compressed.

Time of sowing the seed—As soon as ripe in May, on a bed of fresh loamy earth to be shaded from the mid-day sun, until the plants appear to be well rooted. The Wych elm is almost the only species raised from seed; the other species are raised by layers. The American elms produce seed, but it seldom retains its vegetative powers long enough to be brought to England. A deep loam grows the elm to the greatest perfection. *Uses*—The wood is hard and tough, and resists the effects of moisture better than most other kinds of wood. Its tenacious adhesive quality renders it valuable for many important purposes, keels of ships, naves of wheels, &c.

ELM-TREE.	ULMUS.	Native of	Ft.	
English	*campéstris*	Britain.	80	100
Cork-barked	*suberósa*	——	—	—
Dutch cork-barked	*májor*	——	—	—
Wych	*montána*	——	—	—
Smooth	*glábra*	——	—	—
Pendulous, or weeping	*pendulína*	——	—	—
American	*Americána*	N.Am.	—	—
White Hungarian	*álba*	Hung.	—	—
Curled	*crispa*	N.Am.	—	—
Dwarf	*púmila*	Siberia	—	—
Slippery	*fúlva*	——	—	—
Chichester	*vegéta*	N.Am.	—	—
Winged	*aláta*	——	—	—

There are new varieties of the elm of recent introduction, as the Huntingdon, Chichester, fan-leaved, &c. These exhibit a more rapid and luxuriant growth than the other species mentioned; but their comparative value, as regards the quality of the timber, has not yet, as far as we know, been satisfactorily determined. There is a difference of opinion as respects the comparative value of the wych and the English elms. The weight of opinion is in favour of the English elm, *ulmus campestris*. The corked barked elm is held on all hands to be very inferior, particularly the Dutch species. Where hedge-row timber is at all admissible, the elm is perhaps of all other trees the most to be preferred. The practice of lopping and *pollarding* these trees sadly disfigures the general appearance of the country where it is practised to any extent, and the timber of such pollards is almost always found defective. The wych elm attains to a great size; Marshall (on Planting, vol. ii.) mentions a tree of this kind near Bradley church, in Suffolk, which, in 1754, measured twenty-five feet five inches in circumference, and in thirteen years after measured twenty-six feet three inches, at five feet from the ground.

AMENTACEÆ. *Nat. Sys.*

Eng. Name.	Bot. Name.
WILLOW-TREE.	SALIX.

Dioecia 1, 2, 3, 5, *Andria. Linn.*

Calyx, aments composed of scales; *corolla*, none. In the MALE FLOWER, the nectary consists of a melliferous gland; in the FEMALE FLOWER, the style is bifid. *Seed—vessel* or capsule one-celled, two-valved, downy, numerous, ovate, very small.

Time of sowing seed—March; but generally propagated by cuttings or sets in the spring. *Soil*—Moist soils of almost every description will suit this tree. *Uses*—The osier (*salix viminalis*) affords the materials of the basket-maker; also binders, thatching-rods, rakes, scythe-handles, &c. The other species enumerated, but especially the *Salix Russelliana*, which is perhaps of more rapid growth than the rest, affords poles and rails, and is made use of for a great variety of other purposes.

The bark of the *sálix álba*, Doctor A. T. Thompson observes, supplies the place of the Peruvian bark, in the case of intermittent fevers. It owes its efficacy to a peculiar alkaline principle which has been termed *salicina*, and which can be separated from the other components of the bark.

Timber or Forest Species.

Species, with subserrate villose leaves.

WILLOW-TREES.	SALIX.	Native of	Ft.
Common white	*álba*	Britain	40
Ash-coloured	*cinérea*	——	20
Osier (bushy)	*viminális*	——	
Round-leaved	*cáprea*	——	30

Species with leaves smooth, serrate.

Long-leaved tri-androus	*triándria*	Britain	30
Peach-leaved	*amygdalina*	——	——
Duke of Bedford's	*Russelliána*	——	——
Sweet, or bay-lvd.	*pentándria*	——	
Crack	*frágilis*	——	15
Halbert-leaved	*hastáta*	——	——
Rose	*hélix*	——	——
Golden	*vitellina*	——	——
Weeping	*babylónica*	——	40

Eng. Name.	Bot. Name.
POPLAR.	POPULUS.

Dioecia Octandria. Linn.

Calyx of the ament, a flat scale, torn at the edge; *corolla*, turbinated, oblique, entire; *stigma* of the FEMALE FLOWER, four-cleft; *seeds*, many, ovate, furnished with capillary pappas, which act as wings to carry the seeds by the wind, enclosed in a one-celled capsule.

Time of sowing seed—Propagated by cuttings, suckers, and layers; the first mode preferred. *Soil*—It affects a moist soil, but will grow in almost every description of soil. *Uses*—The chief use of the wood of the forest species is for the turner in the manufacture of trays, bellows, and various domestic utensils. The wood of the Abele poplar is found to be very useful for water-works, having been proved to keep sound for a long series of years when so used*.

The common grey poplar is sometimes confounded with the abele or white species. The leaves of the former are smaller and rounder shaped, and but little cottony underneath, sometimes smooth. The bark of the stem becomes of a beautiful silvery grey hue. This species is of slower growth, but,

* Notwithstanding the general disrepute of the wood of the Lombardy poplar for out-door works, there are instances of its durability being proved, in making close palings, when well saturated with coal-gas tar.

in time, becomes a handsome tree, with the branches of the top more compact than in that of the abele. The leaves of the abele are densely cottony underneath, as are also the young shoots and footstalks of the leaves. The root is powerfully creeping, which unfits the tree to be planted in fields where pasturage or tillage exists. The creeping roots send up suckers, used in propagating the tree. Layers are also used, as well as cuttings of the branches, for the same purpose. It having been doubted whether this or the former was the true abele of the Dutch, where in Holland the abele is highly valued, we procured specimens from a celebrated grower in that country, and these proved, beyond a doubt, that the abele of Holland is the *Populus alba*, or abele of Britain, and not the *Populus canescens*, or grey poplar. The value of this tree, in peaty and low damp soils, is well worthy the attention of the forest-tree planter. Besides the uses of the wood before remarked, it is considered good for wainscoting, floors, laths, and packing cases, indeed, from the boards of it not splitting by, but closing on, the heads of nails, it is considered superior to deal for the latter purpose. The wood of the Lombardy poplar is held in esteem for the like purpose. The bark of the abele is recommended in the cure of intermittent fevers. It should be gathered in summer, when full of sap, and dried by a gentle heat. When powdered, a dram of it is given every four hours between the fits. A white poplar in St. John's College Walks, Cambridge, blown down in a hurricane, Nov. 6, 1795, was forty-two feet in length, and nine feet ten inches in circumference, which, with the limbs, gave 328 cubic feet of timber.

The black Italian poplar attains to a large size in a comparatively short space of time, as is proved at page 89. It delights in moist situations, but grows fast in almost every kind of soil. It is a more valuable tree than the Lombardy poplar, and for upland soils superior to the abele. The timber is used for the like purposes as those of the former. The property of slow combustion seems general in the wood of all the different species of poplar, and this property, which renders the wood valuable for floors and internal works in buildings in case of accidents by fire, renders it of inferior value for fuel.

The aspen, aspe, or trembling poplar, attains to a large size and succeeds well in almost every description of soil, except clay. The roots are very impoverishing to the land, and the aspen is, therefore, confined to local sites. The well-known property of being moved by the slightest current of air possessed by the leaves of this tree, appears to originate in the structure of the petiole, or footstalk of the leaf, the planes of which (being a compressed petiole) are at right angles to those of the body of the leaf, which is itself furnished with two glands, running one into the other. Such are the opinions of Linnæus and of Dr. Stoke regarding this point. But the flattened footstalk is common to all the poplars with which we are acquainted, and all are more or less subject to have the leaves easily put in motion; in fact the structure of the petiole, as now described, will readily explain the matter to the observer, and that in proportion to the length and slender structure of a petiole so constituted to that of the body of the leaf, depends its sensibility of any cause of motion. Lightfoot mentions, that this almost constant trembling of the leaves of the aspen had given rise to a superstitious opinion in some parts of the Highlands of Scotland, that our Saviour's cross was made of the wood of this tree, and that therefore its leaves could never rest.

Among the North American species of poplar, the Canadian (*monilifera*) offers great merits, as far as experience in its culture in Britain affords the means of drawing satisfactory conclusions. It affects a moist, deep, rich soil; such are fertile peat and alluvial soils. Mr. Hursthouse of Tydd, near Wisbeach, planted trees of the *Populus monilifera*; in 1822, and nine years after he had trees of a size to saw into scantlings, which, for toughness of texture, his carpenter stated to exceed any he had before met with. This species is more nearly allied to the *Pópulus angulàta*, or Canada poplar, than to any other species. The Canada poplar is distinguished at first sight by its angular branches. These arise from the lower side of the

base of each footstalk, one from the centre of the base, and one from each side of it. The leaves being arranged alternately on the shoot, and these angles or wings falling or proceeding from the base of each, and terminating at or just before they reach the next bud, or leaf, form five angles of the shoot. When a shoot is divided, the pith exhibits five angles, corresponding to these nerves of the leaf-stalk. A similar arrangement takes place on the shoots of the Canadian poplar, with this exception, that the angles are seven in number instead of five; they are also much less prominent. The botanical characters are specifically distinct; but as these are not often within the reach of the inquirer, the above may be found useful in distinguishing these two species, often confounded together. The magnificent broad shining leaves of the Carolina poplar, with the peculiar habit alluded to, its rapid growth, and general appearance, when advanced to the size of a timber tree, render it well worthy a place in sheltered glades of plantations. The lower part of Virginia, Michaux informs us, is the most northern point at which this species is found in America, it being more common in the two Carolinas, in Georgia and Lower Louisiana, on the marshy banks of the great rivers, where it attains to eighty feet in height, with a proportional diameter. He terms the Canadian poplar *Pópulus Canadénsis*; and he gives our *monilifera* to another species, having a smooth cylindrical stem, but similar to the *Pópulus lævigáta*. He calls our Canadian poplar cotton-wood, and states that it rises to seventy or eighty feet in height, and three or four feet in diameter; and it is preferred as a useful tree. The Ontario, or smooth-leaved poplar, may rank next in order to those just now mentioned, for rapidity of growth and beauty of its foliage. The comparative value of its timber remains to be determined by time. Those other species enumerated below are all deserving of a place in plantations to prove the comparative value of each.

Timber or Forest Species.

POPLAR.	POPULUS.	Native of	Ft.
Com. grey, suc.	*canéscens*	Britain	40
Black, suc. cut.	*nigra*	——	30
Lombardy, cut.	*dilatáta*	Italy	70
Balsam „	*balsamífera*	N. Amer.	40
Athenian „	*Græca*	Greece	—
Canadian „	*monilífera*	N. Amer.	30
Aspen „	*trémula*	Britain	50
Abele-tree, suc.	*álba*	——	40

Ornamental Species.

Carolina, lay.	*anguláta*	N. Amer.	40
Heart-leaved „	*cándicans*	——	20
Various-leaved „	*heterophýlla*	——	—
Smooth-leaved „	*lævigáta*	——	30
Weeping „	*péndula*	——	—
Trembling „	*trépida*	——	—
Large-dented „	*grandidentata*	——	—
Laurel-leaved „	*laurifólia*	Altay.	—
Slender-twigged „	*viminea*	N. Amer.	—

(*Subordo, Betulinæ.*) *Nat. Sys.*

Eng. Name.	Bot. Name.
ALDER-TREE.	ALNUS.

Monœcia Tetrandria. Linn.

MALE FLOWER—*receptacle* of the ament, wedge-shaped, truncated, composed of three flowers; *calyx*, scaly; *corolla*, four-parted; *stamina*, four. FEMALE FLOWER—Ament *calyx*, scaly, or two-flowered; *corolla*, none; *seed*, compressed, oval, naked.

Time of sowing seed—Autumn or spring: if left until spring, preserve them in dry sand. *Soil*—Moist or damp soils are the most fit for the growth of the alder. *Uses*—This tree is the most valuable of the sub-aquatic forest-trees. The wood (see p. 9, fig. 1.) is esteemed for under-water-work, as piles, pipes, pumps, sluices, &c. The charcoal made of its wood is highly valued for the manufacture of gunpowder. The bark and young shoots afford a yellow dye, and also afford a basis for black colours.

Besides the uses just mentioned of the wood of the common alder, the roots and knots furnish a valuable material for cabinets, this part of the wood being often beautifully veined. The bark is used by dyers, tanners, and leather dressers, and for tanning nets. An ounce of the bark powdered and boiled in three-fourths of a pint of water, with an equal quantity of log-wood and solution of copper, tin, and bismuth, six grains each, and two drops of solution of sulphate of iron, will dye a strong deep *boue de Paris*. The Laplanders are said to chew the bark, and dye their leathern garments with their saliva. The shoots cut in March are said to dye a fine cinnamon colour and a handsome drab or tawney when previously dried and

powdered. The value of the charcoal in the manufacture of gunpowder is well known.

Linnæus says that horses, cows, sheep, and goats eat it, but that swine refuse it. The tongues of horses feeding upon it are said to turn black during its use. It is very astringent, and most probably unwholesome to animals as food. In low damp situations, by the sides of streams, &c., it makes the best hedges, as it grows in such situations freely, where the thorn or quick will make little or no progress. In damp situations it is an useful coppice wood. The economical properties of the varieties of the common alder enumerated below have not hitherto been proved; they are ornamental, and deserving of a position in the damp margins of woods.

The American species are considered to be inferior to the common alder as regards the uses of the wood and the bark; nor as yet are there any proofs of the comparative value of the Siberian and European species, beyond that of giving variety to the effects of foliage in plantations.

Timber or Forest Species, and for Ornament, &c.

ALDER-TREE	ALNUS	Native of	Ft.
Common	*glutinósa*	Britain	25
Var. Silver-striped	*fóliis argénteis*	——	—
„ Emarginate	*emarginàta*	——	—
„ Cut-leaved	*incísa*	——	—
„ Jagged-lvd.	*laciniàta*	——	—
„ Oak-leaved	*quercifólia*	——	—
„ Oblong-lvd.	*oblongàta*	S. Europe	—
„ Elliptic-lvd.	*elliptica*	——	—
Hoary-leaved	*incana*	Europe	—
Var. Angular-leaved		——	—
„ Winged		——	—
Broad-leaved	*macrophýlla*	——	—
Siberian	*Sibérica*	Siberia	—
Saw-leaved	*serrulàta*	N. Amer.	—
Wave-leaved	*undulàta*	Canada	—
Glaucous	*glaúca*	N. Amer.	—
Red	*rúbra*	——	—
Dwarf	*púmila*	——	—
Heart-leaved	*cordifólia*	——	—

Eng. Name. BIRCH-TREE. Bot. Name. BETULA.

Monœcia Polyandria. Linn.

ALE FLOWER—scales of the *ament*, imbricated, shield-shaped, and three-flowered; *calyx*, one scale; *corolla*, none; *stamina*, ten to twelve. FEMALE FLOWER—*ament*, imbricated; scales of the *calyx*, two-flowered; *corolla*, none; *seed*, one, winged.

Time of sowing seed—Autumn or spring; to be kept in dry, cool sand, from the time it is ripe until it is sown. *Soil*—The birch will grow in every description of soil, from the wettest to the driest. *Uses*—The wood is chiefly used by the wheelwright and turner; it affords good charcoal; its soot is esteemed as an ingredient in printers' ink; the bark is of use in dyeing wool yellow; but the chief use of the tree is for underwood. The spring sap of the birch-tree has a saccharine quality, and is sometimes made into wine. The weeping birch is a very ornamental plant.

The common birch is found in the highest latitude or limits of the growth of trees. In the 70th degree of north latitude, its stature is reduced to that of a shrub, and it is singular that the opposite extreme of a warm or dry atmosphere has a similar effect in preventing its growth. Michaux assumes the 45th parallel as the limit below which the common birch is only accidentally found in forests, unless on high elevated sites where the temperature is sufficiently low. Although the merits of the wood of the birch will not allow of its ranking as one fit for planting on soils where the more valuable forest-trees will attain to due perfection of growth, yet for certain poor elevated soils it is highly valuable, and on very wet or springy land it will be productive; there are instances known of its produce on soils so poor as scarcely to carry any thing else but moss, affording in ten years growth the value of ten pounds per acre. In the northern parts of Europe it attains to seventy feet in height, and two feet in diameter. In Sweden, Norway, and Finland the inhabitants avail themselves of its wood, bark, leaves, and sap, for a great variety of economical uses, for almost all the implements of husbandry, elegant articles of furniture, for bowls, plates, spoons, chairs, &c. The bark is used for the manufacture of boxes, baskets, and sandals; its durability is so great that it is used in preserving parts from decay by wrapping it round them. The Laplanders prepare the skin of the rein-deer with the bark. They cut the bark into small pieces, which they macerate, and afterwards boil in water, with the addition of a little salt. The skins are plunged repeatedly into this decoction warmed, and are allowed

to remain in it several days. They are then taken out, and rendered pliable and soft, and in this state they are scarcely permeable to water. In Russia, by slowly burning the bark in kilns, an empyreumatic oil is obtained with which leather is prepared, highly esteemed for durability. Evelyn enumerates a great variety of uses to which the birch is applicable, and Lightfoot gives details of its uses in the Highlands of Scotland. In America, the black birch is considered the most interesting of the species of that country. In some parts of the United States, it goes by the name of black birch; in Virginia, mountain mahogany; and in Connecticut, sweet birch; and in Canada, cherry birch. In deep loose soils Michaux has observed some seventy feet high, and two to three feet in diameter. The habit of this species is admired for its foliage, and its odoriferous flowers. In the Annals of the Arts a stock of this species is stated to have attained the height of forty-five feet in nineteen years. It is highly deserving a place in British forests.

The white birch, as it is called in America, or *Bétula Populifólia*, seldom rises to more than twenty-five feet in height. The distinctness of its foliage is its only recommendation at present known, for its wood is considered of inferior quality. The red birch of Michaux, or the *Bétula lanulósa* of our list, is chiefly found in Maryland, Virginia, and the upper parts of the Carolinas and of Georgia; it is seldom found farther north than New York. The epidermis of the bark of trees not exceeding eight or ten inches in diameter, is of a red or cinnamon colour, but on large trees (it sometimes attains to seventy feet in height) the bark is of a greenish hue. The twigs of this species are considered superior to those of any other species for the purpose of making brooms. The paper birch is considered by some to surpass the common species in size and value of its wood. In Canada, and the district of Maine, the country people place large pieces of the bark immediately below the shingles of the roofs of their houses, as it forms a lasting and very impenetrable barrier to the rains. Various articles are manufactured of it, such as portfolios, &c, which are sometimes embroidered with silk of different colours. When divided into very thin sheets, it forms a substitute for writing paper; but the most important use, Michaux observes, to which it is applied, is in the construction of canoes. To procure proper pieces of the bark for this purpose, the largest and smoothest boles are selected. In the spring two circular incisions are made several feet apart, and two longitudinal ones in opposite sides of the bole; after which, by introducing a wooden wedge, the bark is easily detached. These plates are usually ten or twelve feet long, and two feet nine inches broad. To make the canoe, they are stitched together with fibrous roots of the white spruce, about the size of a quill, which are deprived of the bark, split and made supple by immersion in water. The seams are coated with resin of the balm of Gilead fir. Great use is made of these canoes by the natives and French Canadians in their long journies into the interior of the country—they are very light, and are easily transported on the shoulders from one lake or river to another. A canoe calculated to carry four persons, with their baggage, weighs from 40 to 50lbs.—some of them are made to carry as many as fifteen persons*. Upon the whole, this species appears to be well worthy the attention of the British forest-planter of certain descriptions of soil. Of the other species of birch enumerated below, the last seven are of dwarf stature, and fit only for cover, or for the margins of woods; at least the experience that has as yet been had of their culture does not warrant any further recommendation of them at present; but with these, as with numerous other species of trees, extended experience, and careful observation of their properties, and most suitable soils, are wanted, before satisfactory conclusions can be arrived at, as to their relative or comparative values.

Timber or Forest Species.

BIRCH-TREE.	BETULA.	Native of	Ft.
Common.....	*álba*.....	Britain...	40

* North American Sylva, vol. ii., p. 88.

† The *Rhododéndron ponticum* is an instance to shew that a plant may be long known only for its ornamental properties. It was introduced into England in 1763, and it is only of late years that its value for underwood and cover, in sandy and peaty soils, has been discovered and taken advantage of.

BIRCH-TREE.	BETULA.	Native of	Ft.
Var. Warted	*verrucósa*	——	——
„ Weeping	*péndula*	——	——
„ Palmate-lvd.	*dalecárlica*	——	——
„ Eastern	*póntica*	Asia	
„ Large-fruited	*macrocárpa*		
Pubescent	*pubéscens*	Europe	
Poplar-leaved	*populifólia*	N. Amer.	
Tall	*excélsa*	——	
Woolly	*lanulósa*	——	
Yellow	*lútea*	——	
Black	*nigra*	——	
Daurian	*dahúrica*	Dauria	
Paper	*papyrácea*	N. Amer.	
Soft	*lénta*	——	
Hornbeam-leaved	*carpinifólia*	——	
Carpathian	*carpáthica*	CarpathianMt.	

Species for Ornament, Shelter, &c.

Oval-leaved	*ovata*	Europe
Alnus	*viridis decand.*	—
Shrubby	*fruticósa*	Siberia
Glandular	*glandulósa*	N. Amer.
Hairy-dwarf	*púmila*	——
Smooth-dwarf	*nána*	Scotland
Var. large-leaved	*macrophýlla*	
Dark	*tristis*	Kamtschatka

Eng. Name.	Bot. Name.
HORNBEAM-TREE.	CARPINUS.

MALE FLOWER—*ament*, imbricated; scale of the *calyx*, ciliate; *corolla*, none; *stamina*, ten. FEMALE FLOWER—*ament*, imbricated; scale of the *calyx*, two-flowered; *corolla*, three-cleft; *seed*, a nut, ovate, angular, furrowed.

Time of sowing the seed—Autumn. *Soil*—Poor clayey loams, incumbent on sand, and chalky gravels, are well adapted for the growth of the hornbeam. *Uses*—The wood (see page 9, *fig. f*) of the hornbeam, as its name would imply, is extremely tough, or flexible, and hard, and valuable for many useful purposes; but the tree being chiefly cultivated for underwood, few opportunities are offered to the carpenter to prove its value in large scantling. Its value for every purpose where the properties above mentioned are essential, such as mill-clogs, heads of beetles, stocks and handles of tools, yokes, &c., is well-known. Like the beech, it is good fuel, makes superior charcoal, and affords excellent potash. It grows in exposed situations, and on very poor, cold, thin, damp soils, where many other species of forest-trees would make little progress. The leaves continue to adhere to the branches long after vegetation in them appears to have ceased. This property renders the plant valuable for the purposes of shelter, whether when singly planted or in rows, to be cut as a hedge. On soils of the nature mentioned, the hornbeam should always have a place, if not exclusively, at least in a considerable proportion to other species of trees. The varieties of the common hornbeam, mentioned below, are not otherwise interesting to the forest-planter than as regards the effect of foliage, and as subjects illustrative of the laws of vegetable economy.

The American hornbeam is found wild as far north as Nova Scotia, New Brunswick, and Lower Canada. By the French inhabitants of Upper Louisiana it is called *Charme*. It never exceeds thirty feet in height, and its more ordinary dimensions scarcely entitle it to rank as a timber tree. The trunk is similarly fluted as that of the foregoing species.

Timber or Forest Species.

BETULINÆ. *Nat. Sys.*

HORNBEAM-TREE.	CARPINUS.	Native of	Ft.
Monœcia Polyandria. Linn.			
Common	*bétulus*	Britain	30
Var. Oak-leaved	*quercifólia*	——	
„ Striped-leaved	*variegáta*	——	
„ Cut-leaved	*incisa*	——	15
American	*americana*	N. Amer.	20
Species for Ornament, &c.			
Eastern	*orientális*	Levant	12

Eng. Name.	Bot. Name.
HOP-HORNBEAM.	OSTRYA.

Monœcia Polyandria. Linn.

MALE FLOWER—*ament*, imbricated; *calyx*, one scale; *corolla*, none; *filaments*, ramose. FEMALE FLOWER—*ament*, naked; *calyx*, none; *corolla*, none; *capsule*, inflated, imbricated; *seed*, one at the base.

Propagated in England by grafting on the common hornbeam and by layers. *Uses*—The wood of the hop-hornbeam, or iron wood of America, is heavy, compact, and tough, and is used in America, Michaux informs us, for levers, brooms, and scrubbing brushes; the latter are made by rolling back very thin slices of the wood, adhering to a piece of suitable dimensions. In America it is considered a tree of the third order as to size, rarely exceeding thirty-five feet in height, and twelve or fifteen inches in diameter. It is never found in masses, but scattered

in the forests, and is more common near Lakes Ontario and Erie, than elsewhere. The Virginian or flowering hop-hornbeam attains to a greater height than the former, It is a more ornamental tree, the leaves being larger and of a finer tint of green; the value of the wood is similar to that now mentioned.

Species for Ornament, &c.

HOP-HORNBEAM, OR IRON-WOOD.	OSTRYA.	Native of	Ft.
Common	*vulgáris*	Italy	20
Virginian	*virgínica*	N. Amer.	—

CUPULIFERÆ. *Nat. Sys.*

Eng. Name. HAZLE-TREE. Bot. Name. CORYLUS.

Monœcia Polyandria. Linn.

MALE FLOWER—*ament*, imbricated; *calyx*, a scale; *corolla*, none; *stamina*, eight. FEMALE FLOWER—*calyx*, two-parted, lacerated; *corolla*, none; *styles*, two; *seed*, an oval nut, fixed in the calyx, which remains permanent.

Time of sowing—February: should be preserved in sand moderately dry, during the winter. If the fruit be an object, the best kinds must be propagated by layers. *Uses*—Underwood or coppice, which, being of under size, is applied to the purposes of making hoops, spars, forks, hurdles, withes, wattling, crates, &c., for which it is esteemed. It may be cut every seven years. Mr. Belcher, in Young's Annals, vol. viii. p. 186, mentions, that in Kent the best soil for the filbert is a strong loam, the fruit produced upon which is large and not maggoty; and that an acre has sometimes been sold for 50*l*. They are generally planted at 12 feet apart, the intervening ground being occupied with green crops, the culture of which requiring the frequent use of the hoe, is productive of benefit to the filbert plant, which is kept pruned to the height of six feet, and the diameter of the bush thus formed to about the same dimensions. The Constantinople hazel attains to the size of a tree. It was introduced into England in 1665, by Mr. John Rea. Linnæus mentions a very large tree of it in the Leyden Garden, in 1736, sown there by Clusius, above a century before. It is too much neglected by planters in England. The raceme, or fruit-bunch, is very large in this species, and the individual nuts are twice the size of those of the common hazel.

Species for Ornament, &c.

HAZLETREE.	CORYLUS.	
Common	*avellána*	Britain
Var. White filbert	*álba*	—
„ Red filbert	*rúbra*	—
„ Oval-fruited	*ováta*	—
„ Barcelona	*barcelonénsis*	Spain
„ Cobnut	*grándis*	Britain
„ Clustered	*glomeráta*	—
Lambert's	*tubulósa*	S. Europe
Dwarf American	*húmilis*	N. Amer.
Cuckold	*américána*	—
Common do.	*rostráta*	—
Constantinople	*colúrna*	Constan.

CUPULIFERÆ (*subordo third*). *Nat. Sys.*

OAK-TREE. QUERCUS.

Monœcia Polyandria. Linn.

MALE FLOWER—*calyx*, bell-shaped, half fine-cleft; *corolla*, none; *stamina*, five to ten. FEMALE FLOWER—*calyx*, bell-shaped, entire, rough; *corolla*, none; *style*, one; *stigma*, three; *seed*, a nut (acorn), ovate, cylindrical, fixed in a short hemispherical cup.

Time of sowing—Beginning of November; or if deferred till spring, lay them upon a cool dry floor, to prevent their sprouting or vegetating. *Soil*—A rich loam, with a clayey subsoil, brings the oak to the greatest perfection; but it may be profitably cultivated on almost every description of soil, except boggy or peaty. *Uses*—The value of oak timber is too well known to need any description here. It has already been mentioned at p. 24, that there are two species or varieties of the British oak, *Quercus robur*, which differ considerably from each other in the value of their timber. They are considered by some botanists as merely varieties, *Quercus robur* pedunculata, et *Quercus robur* sessiliflora; while others, as Sir James Smith, makes them distinct species, *Quercus robur* et *Quercus sessiliflora*. The footstalks of the fertile *flowers*, *acorns*, and *leaves*, afford the most obvious character of distinction: in the former or more valuable variety, the footstalks of the flowers and acorns are longer, while in the inferior variety the footstalks are very short, or scarcely perceptible. On the contrary, as regards the *leaves*, the footstalks of the *Quercus robur* are shorter than in those of the *Quercus sessiliflora*, and the body of the leaf is likewise

less equally and regularly divided. The Durmast oak, *Quercus pubescens*, has been considered a variety also, but having an inferior quality of wood, it is perhaps better to consider it a distinct species. The distinguishing character of this species is in having the under side of the leaf pubescent; in other respects it nearly agrees with the *Quercus sessiliflora*, in having the leaf and fruitstalks almost sitting, and the leaves less deeply indented. The leaves of the inferior species are also observed to hang longer on the tree; sometimes they continue all the winter, approaching towards the character of an evergreen. This last distinction, however, is not always to be depended on, as the soil and health of the individual tree influence its habit in this respect. In our own experience we have by no means found this inferior species, *Quercus sessiliflora*, and its near ally to the Durmast oak, *Quercus pubescens*, so common as the foot-stalked oak, *Quercus robur*; but, on the contrary, comparatively uncommon. Although there are not such clear and specific facts recorded of the comparative difference of value between the quality of these two species of oak, as to determine the exact amount of loss which is occasioned every time the acorns of the inferior species are used for planting, instead of those of the more valuable above mentioned, yet the general opinion being so strong in favour of the superiority of the foot-stalked oak, that it is of much importance to collect and sow the acorns of that species only*. We have already, at p. 23, 24, 25, described the mode of rearing the oak from the acorn on the spot where it is to remain for the production of timber; the soil on which it attains to great perfection (p. 49), and the best size of plants, from nursery rows, when the more general mode of rearing oak by transplanting is adopted (p. 34.) We have before also mentioned some oak trees remarkable for the perfection of growth they had attained; and did the limits of these pages permit, we could add greatly to the number from specimens which were, or are now in Earl Powis's Park, near Ludlow; Earl of Surrey's, Worksop; Lord Bagot's in Staffordshire; Lord Holland's, Ampthill Park*, Bedfordshire; Withy Park, Shropshire, Dennington Park, Berkshire, in the weald of Kent, New Forest, Hampshire, &c. These two species of oak constitute a considerable portion of the forests, from the sixtieth to the thirty-fifth degree of north latitude, extending over a portion of the north of Asia, and the northern point of Africa.

The common oak is considered to be the longest lived tree of the British forests. Those in the New Forest, mentioned by Mr. Gilpin in his Forest Scenery, v. ii. p. 63, which 'chronicle on their furrowed trunks, ages before the Conquest,' give an idea of the very great length of existence this species of tree is capable of maintaining; but for facts, on which to found a satisfactory conclusion of the average duration of vegetable life in this, and other forest-trees, we have only the test mentioned at p. 5, that of ascertaining the number of the concentric circles in the transverse section of the root, stem, or branch of the tree, and how-

* The specific botanical characters are, according to Sir J. Smith, as follows:—'*Quercus robur*—*Leaves*, deciduous, oblong, wider towards the extremity; their sinuses rather acute; lobes obtuse. *Fruit-stalks*, elongated.'—'*Quercus sessiliflora*—*Leaves* on elongated stalks, deciduous, oblong, with opposite acute sinuses. *Fruit*, sessile.'—Engl. Fl. p. 149—150.

The above discriminating characters are, according to our experience, as clear as the nature of the distinctions described will admit, but scarcely sufficient to constitute species.

* The circumference of one of these oaks at its base measures upwards of 40 feet, at its mean height about 30 feet: it is nearly hollow, and exhibits a concavity apparently sufficient to contain four or five middle-sized persons standing together withinside. The branches have been of very large dimensions, and one that still remains is equal in size to many a parent oak. The age of this tree must be very great, but the loss of the central wood will prevent the period of its age or duration being ascertained; and we believe there are no records of the planting of these oaks otherwise to determine this interesting point. The following lines are inscribed on a plate affixed to this remarkable oak:

Majestic tree! whose wrinkled form hath stood,
Age after age, the Patriarch of the wood;
Thou who hast seen a thousand springs unfold
Their ravel'd buds, and dip their flowers in gold,
Ten thousand times yon moon relight her horn,
And that bright star of evening gild the morn;—
Gigantic oak! thy hoary head sublime
Erewhile must perish in the wrecks of time.
Should round thy head innocuous lightnings shoot,
And no fierce whirlwind shake thy steadfast root,
Yet shalt thou fall; thy leafy tresses fade,
And those bare, scatter'd antlers strew the glade:
Arm after arm shall leave the mould'ring bust,
And thy firm fibres crumble into dust.
The Muse alone shall consecrate thy name,
And by her powerful art prolong thy fame;
Green shall thy leaves expand, thy branches play,
And bloom for ever in th' immortal lay!

ever satisfactory this test may be for this important object, it is but too seldom employed, if we are to judge by the few records of the ages of valuable trees, not only of the oak, but of all others of the first class of timber that are to be found. Were records of planting kept in the family archives of those who plant; containing the facts of the age of the plants, when transplanted to their timber sites, the nature and preparation of the soil at the period of planting, and the after culture until the trees attained to a timber size, the benefit to science and to practice would be great. (See note, *p. 11.)

The Turkey oak, *Quércus cérris*, was introduced into England in 1739. It is a handsome growing tree, and is perhaps the most valuable species next to the British oak. It will thrive on most kinds of soil; but a strong loam is that which it most affects. The wood exhibits all the good properties of that of the common oak; but the period of its introduction into England has not allowed of any sufficient trial to determine its comparative durability. It is highly deserving of a place in every plantation of forest-trees, where the soil is adapted to the growth of the oak, elm, and chestnut. The acorns are oblong, and the cup mossy. The leaves are deciduous, and readily distinguished from those of the common oak by their ovate-oblong shape and slightly flat sinuate margins.

Michaux informs us, that there are forty-four species of oak found in America between the 20th and 48th degree of north latitude: of these he has described and figured twenty-six species*, which are all interesting for their different habits of foliage and growth; for general utility, however, there appears to be not one equal to our own native species, *Quercus robur*. The white oak before noted approximates nearer in valuable properties to the British oak than any other. In favourable situations it rises to seventy or eighty feet in height, and six or seven feet in diameter. To inquiries made to English, French, and American shipwrights, this intelligent author learnt that the general opinion agreed in the conclusion, that European oak was tougher and more durable from the superior closeness of its grain, but that the American species was more elastic, and required a shorter time, and only half the weight to bend it; and he judiciously adds, that this advantage, though important in ship-building, does not compensate for the openness of its pores. In America it is much used in the construction of mills and dams, where it is exposed to be alternately wet and dry. The wooden bridge—nearly three thousand feet long, that unites Boston and Cambridge—is supported by posts of white oak, from sixteen to twenty feet in length, which have replaced those of white pine, on which it originally stood.

The American mossy-cup oak has the lobe of the leaves so deeply indented as to give them the appearance of pinnate-leaves. The branches of the first and secondary limbs have a pendulous habit, which, with its generally handsome top, claims for this species a place in plantations. The quality of its timber has not been proved in England. In America it attains to sixty or seventy feet in height.

The over-cup white oak is distinguished for the largeness of the leaves. In

* His arrangement is as follows:—First, fructification annual, with lobed leaves.
White-oak.....*quércus álba.*
European oak.....*róbur.*
European white oak..*róbur pedunculáta.*
Mossy-cup white oak..*olivæfórmis.*
Over-cup oak .....*macrocárpa.*
Post oak .....*obtusilóba.*
Over-cup oak .....*lyráta.*
Second:—Leaves toothed.
Swamp-white oak .....*díscolor* vel *Michauxii.*
Chestnut-white.....*palústris.*
Rock-chestnut.....*montana* vel *montícola.*
Yellow oak .....*acumináta* vel *castánea.*
Small chestnut oak....*prínos* vel *prinoides.*
Division 2d. Fructification biennial; leaves mucronated, except the thirteenth species.
Section first—leaves obtuse or entire:—
Live oak.....*vírens*
Cork oak .....*súber.*
Willow-leaved.....*phéllos.*
Laurel .....*imbricária* vel *laurifólia.*
Upland .....*cinerea.*
Running .....*púmila.*
Section second—leaves lobed:—
Bartram oak.....*heterophylla.*
Water oak.....*aquática.*
Black oak .....*nigra* vel *ferruginea.*
Bear oak.....*Banistéri.*
Third section—leaves multifid, or many cleft:—
Barren-scrub oak .....*quércus Catésbœi.*
Spanish oak .....*falcáta.*
Black oak .....*tinctória.*
Scarlet oak.....*coccínea.*
Grey oak .....*ambígua.*
Pin oak .....*palústris.*
Red oak.....*rúbra.*

the United States they are found to measure frequently fifteen inches long and eight broad. The acorns are large, and the lips of the cup are frequently fringed with a series of flexible filaments. This tree is also deserving of a place in British plantations.

The lobed-leaved, or post oak, is a tree of a secondary size. Michaux states, that the preference given in the West Indies to the staves from Baltimore and Norfolk is due, in a great measure, to their being made of the wood of this species. It is an ornamental tree, but its merits for the produce of timber have not yet been proved in England.

The over-cup oak, or lyre-leaved, affects a moist soil, and is of a large habit of growth. The shape of the leaves and general habit of the tree render it interesting. It has not yet received in England the requisite time and culture to prove its properties for the produce of timber. In America Michaux states its height to be eighty feet, and its circumference eight to twelve feet.

The swamp oak, *Quércus díscolor*, is much less common in America than many of the other oaks. We have seen only one plant of it in England. Michaux describes it as a beautiful tree, more than seventy feet high; the leaves six or eight inches long and four broad, smooth and of a dark green above, and downy underneath. We believe this species to be nearly allied to the British durmast oak, *Quércus pubéscens*.

The chestnut white, or marsh oak, *Quércus Michaúxii*, is considered to be one of the most majestic trees of the American forests. It is described, according to the above, as rising to ninety feet in stature, with a straight clear stem of fifty feet, crowned with an expansive summit. The timber of it is considered inferior to the white oak, though superior to some other species. We have seen young trees only of it in England.

The rock chestnut leaved yellow oaks are as yet only distinguished for the shape of their leaves, which more or less resemble those of the sweet chestnut. The last mentioned is considered the most interesting. The acorns are of an inferior size, but of a sweeter quality than those of the other species mentioned. The small chestnut oak rarely exceeds thirty inches in height, and ought perhaps to have been passed over here without notice; however, it is very prolific, and where acorns are in request for the food of game, pheasants for instance, this dwarf oak may be planted with advantage. The acorns are very sweet. 'Of its habits in its native soil,' Michaux remarks, that 'Nature seems to have sought a compensation for the diminutive size of this shrub in the abundance of its fruit; the stem, which is sometimes no bigger than a quill, is stretched at full length upon the ground by the weight of its thickly clustering acorns.'

The live oak, *Quércus vírens*, was mentioned at p. 45,* as highly deserving of a trial in situations on the southern coast. Michaux remarks, that it is never found farther than from fifteen to twenty miles from the shore. The eminent success of Mr. Lucas in transplanting trees of large growth of this species selected from the woods, on his estate at Middleburg, prove clearly its vivacious habits. It appears to be confined to the southern states of North America, *viz.* the Floridas and Louisiana, as its natural soil and climate, extending no farther north than Norfolk in Virginia. He further mentions, that in the course of four or five hundred miles between Cape Canaveral in East Florida, to Savannah in Georgia, he frequently saw it on the beach, or half buried in the movable sands on the downs, where it had preserved its freshness and vigour, though exposed during a long lapse of time to the fury of the wintry tempest, and to the ardour of the summer's sun. Its usual height in its native soil is from forty to forty-five feet, and one foot in diameter. The leaves are evergreen. The wood is extremely hard, tough, and very lasting. It is used for ship-building, screws, cogs for mill wheels, and other purposes, for all which it is preferred to the white oak.

The cork-tree, or cork oak, is a native of the south of Europe; it was introduced into England about ninety or a

* We here beg to correct a passage by inserting an omission at page 45, line 18 from the top; after the words, 'the live oak will not exist in England,' add, '*in elevated exposed situations.*'

hundred years ago*. It is found growing naturally in the south of France, in Spain, Portugal, and in some parts of the states of Barbary. It rarely exceeds forty feet in height and three feet in diameter. The wood is considered to be less durable than the common oak, although it is compact and heavy. Its growth in England is confined to warm sheltered situations. In exposed situations it cannot be reared. The largest we have seen in England is in the Royal Gardens, Kew, where its characteristic property, that of producing in perfection cork-bark, was, when we saw it a few years since, very evident and interesting. Abroad the cork is considered fit to be first taken from the tree when it reaches twenty-five years of growth, but this product is not of a quality to be used for better purposes. In ten years it is renewed, but it is not until the tree has attained to the age of forty-five or fifty years that the bark possesses all the requisite property for good corks. July and August are the seasons for taking it from the trees, which is carefully done, so as not to wound the alburnum; for should this happen (it may be unnecessary here to state), the cork bark is not again renewed on that part. The acorns should be sown as soon as received from abroad in small single pots, and shifted into larger as the roots increase, until the plants are from one to two feet high, when they may be transplanted for good; they may, however, be kept until they are six feet or more in height, provided care be taken to prevent the tap-root from passing down below the pot to any great length. The ilex, or evergreen oak, may be reared with advantage in the same manner as that now described. It is more hardy than the preceding tree. Its merits for ornament and shelter are well known; it appears to have been introduced into England from the south of France in 1581.

The kermes oak, *Quércus coccífera*, is worthy of remark here, although of so humble a habit of growth as not to attain the size which constitutes a timber tree. The scarlet, or red purple dye of the name, which supplanted the substitute obtained from a species of the *murex*, shell-fish, and used for the anciently celebrated Phœnician *purple* dye, is afforded by this oak-shrub (for the plant seldom rises above five feet, and often does not exceed two,) in the form of small red galls, caused by the puncture and subsequent deposition of the eggs of an insect, called *coccus ilicis*. This dye, in its turn, however, has been supplanted by the *cochineal cóccus cácti*, an insect itself, found on one or more species of the *cáctus*, or Indian fig, but more particularly the *Cáctus cochinillifer* or the *Opúntia cochinillífera*. The kermes oak is a native of the south of Europe, and was introduced into England about 1683.

Of the other species of oak enumerated below, the dyers' oak, *Quércus tínctoria*, demands notice, on account of its bark furnishing the yellow dye, *quercitron*, a substance much used in dyeing wool, silk, and paper-hangings It is the cellular integument of the bark that supplies the colouring matter. Doctor Barncroft states, that one part of *quercitron* is equal to ten parts of *woad*. It is stated, that to dye wool it is sufficient to boil the quercitron with an equal weight of alum; in dipping the stuff the deepest shade is given at first, and afterwards the straw-colour*. This species of oak appears to have been introduced into England as early as 1739; but its useful property now alluded to seems not to have been proved, or, in fact, tested in this climate. Its wood is considered inferior to that of the common oak.

Timber or Forest Species.

OAK-TREE.	QUERCUS.	Native of	Ft.
Common.....	*róbur pedunculáta*	Britain	60
Sitting acorned..	*sessiliflóra*..	——	40
Woolly-petioled, or Durmast..	*pubéscens*	England..	—
Turkey-mossy-cups	*cérris*.....	S. Europe	50
Var. Rough-lvd do.	*bullàta*.....	——	—
„ Nar.-lvd. do..	*sinuáta*....	——	—
„ Fulham.....	*dentáta*....	——	
Evergreen.....	*ílex*.....	——	—
Var. Notch-lvd. do.	*serráta*....	——	—
„ Long-leaved .	*oblónga*....	——	—
„ Lucomb's...	*lucombeána*.	Levant	—
Champion red....	*rúbra*.....	N.Amer...	80
Var. Mountain red	*montána*...	——	—

* The Hortus Kewensis states it to have been introduced into England in 1699, by the Duchess of Beaufort.

* North American Sylva., i. p. 98.

Species for Ornament, or whose value for Timber of British growth has not yet been ascertained.

OAK-TREE.	QUERCUS.	Native of	Ft.
White*	*álba*	N. Amer.	70
Willow-leaved	*phéllos*	——	50
Live	*vírens*	——	40 to 45
Ash-coloured	*cinérea*	——	18..20
Laurel-leaved	*laurifólia*	——	40
Var. Blunt do.	*obtúsa*	——	
Tile-cupped	*imbricáta*	——	40
Holly-leaved	*gramúntia*	——	
Cork-tree	*súber*	S. Europe	
Kermes	*coccífera*	——	2 to 15
Broad chestnut-lvd.	*prínus*	——	80
Var. Long-leaved	*oblongáta*	——	
Common water	*aquática*	N. Amer.	40
Var. Vari.-lvd. do.	*heterophýlla*	——	20
„ Long-lvd. do.	*elongáta*	——	30
„ Entire-lvd. do.	*indivisa*	——	
„ Nar.-lvd. do.	*attenuáta*	——	
Black	*nígra*	——	30
Three-lobed	*trilóba*	——	
Downy-leaved	*elongáta*	——	
Dyers	*tinctoria*	——	90
Scarlet	*coccínea*	——	80
Marsh	*palústris*	——	90
Ilex-leaved	*ilicifólia*	——	
Gt. prickly-cupped or Velanida	*ægilops*	S. Europe	
Italian	*æsculus*	——	
Starred	*stellata*	N. Amer.	40, 50
Lyre-leaved	*lyráta*	——	80
Grey	*boreális*	——	50
Bear-oak	*banistéri*	——	3, 4
Beech-like	*faginea*	S. Europe	
Hisped-cupped	*haliphléos*	France	
Soft-jagged-leaved	*Tauzin*	S. Europe	
Austrian	*Austríaca*	Austria	
Amer.-mossy-cup	*ovalæformis*	N. Amer.	
Clustred	*conglomeráta*	Europe	
Cypress	*fastigiáta*	Pyrenees	
Repand	*repánda*	N. Amer.	
Cork-like	*pseúdo-súber*	Spain	
Over-cup-white	*macrocárpa*	N. Amer.	60
Barren-scrub	*catesbæi*	——	10, 20
Dwarf	*nána*	——	
Spiny-leaved	*agrifólia*	——	
Dwarf-chestnut	*prinoides*	——	
Yellow-chestnut	*castánea*	——	70
Swamp-white	*micháuxii*	——	80
Rock-chestnut	*montána*	——	40, 60
Two-coloured	*bícolor*	——	70
Turner's	*Turnerii*	——	
Levant	*infectória*	Levant	

* The white oak is in high estimation in North America. Michaux states that the value of staves made of this species of oak received by England in 1808 amounted to 146,000 dollars, and the number of staves sent to the West Indies exceeded 53,000,000. The price has varied greatly within the last hundred years: 1720, three dollars a thousand; in 1798, eighteen dollars; and in 1808, thirty dollars. In 1807, before the American embargo, they were advertised at fifty-five dollars, and in 1808, after that municipal regulation, at one hundred dollars!

OAK-TREE.	QUERCUS.	Native of	Ft.
Subdeciduous	*castellána*	S. Europe	
Glossy-leaved	*lezermiána*	——	
Spreading	*expánsa*	——	
Calycine	*calycína*	——	
Portugal	*lusitánica*	Portugal	
Crenated	*crenáta*	S. Europe	
Running	*sericea*	N. Amer.	20in.
Sea	*maritima*	——	*3,8

Cupuliferæ. Nat. Sys.

Eng. Name.	Bot. Name.
BEECH-TREE.	FAGUS.

Monœcia Polyandria. Linn.

MALE FLOWER—*calyx*, bell-shaped, five-cleft; *corolla*, none; *stamina*, five to twelve. FEMALE FLOWER—*calyx*, four-cleft; *corolla*, none; *styles*, two or three, three-cleft; *seeds*, an angular or three-corner shaped nut, one or two contained in each muricate capsule, which opens with four valves, and emits the seeds or nuts.

Time of sowing the seeds—from October to February: they require particular protection from field-mice and other vermin. *Soil*—Siliceous, sandy soils are well adapted for the growth of the beech; or it will attain a great size in elevated clayey loams incumbent on sand: it will prosper on chalky, stony, barren soils. *Uses*—It is used by cabinet-makers, turners, mill and wheel-wrights, for cogs, spokes, and felloes. In the dockyards it is used for wedges, &c. It is also used by musical-instrument-makers for sounding-boards, &c.; by coopers for clapboards. Near large towns it is in great demand for billet-wood. It affords a large quantity of potash and good charcoal.

In Devonshire, where the severity of the western winds is great, the beech appears to withstand the bad effects better than most other kinds of trees, and this hardy habit of it renders it valuable for planting in high chalky and gravelly soils, where shelter is of so much importance to the surrounding lands. According to Vancouver†, the beech and sycamore are found most powerful to resist the rigour of the westerly gales. The nuts, or *mast*, of the beech afford an oil‡ by expression,

* Michaux, in his 'North American Sylva,' states, that there are found forty-four species of oak between the 20th and 48th degrees of north latitude of that continent.

† Survey of Devon, p. 251.

‡ It is considered next in fineness to the olive oil. According to Michaux, the forests of Eu and Crécy, in the department of the Oise, have yielded in a single season two millions of bushels of beech-nuts.—Ibid.

which the poorer inhabitants of Silesia are said to use as a substitute for butter. The nuts are sometimes roasted, and used for coffee. This tree is a native of the greater part of Europe, but is not found so far north as the northern provinces of Sweden. In England it prevails most in the range of chalk hills which run from Dorsetshire, through Wiltshire, Hampshire, Surrey, Sussex, and Kent, and more partially in Berkshire, Buckinghamshire, and Hertfordshire. It is not uncommon also on the Cotswold Hills in Gloucestershire, and in some parts of Monmouth. In Scotland, where its being indigenous is doubted, large plantations have been made, particularly by the Earl of Fife in Murrayshire, and by George Ross, Esq., of Cromarty. In certain cantons of Belgium, particularly near the village of St. Nicholas, between Ghent and Antwerp, very solid and elegant fences are made by planting young beeches seven or eight inches apart, and bent in opposite directions, so as to cross each other, and form a trellis. During the first season they are bound together by osiers at the points of intersection, and in time become grafted, forming apertures of four or five inches in diameter.

The bark of the American white beech is used for tanning leather, when there is a scarcity of oak bark: the leather made from it is white and durable, but inferior in this last respect to that tanned with oak bark. The purple or broad-leaved American beech is held in higher esteem in North America than the former. It is a hardier and a larger-growing tree. The timber is described as being less compact or solid than that of the English beech; planks of it, however, three inches thick, are exported to England. In summer, while the sap is in the vessels of the wood, it is considered a superior season for felling the beech to that of winter; and Michaux states that experience has demonstrated the fact, that the timber felled in the former season is greatly more durable than that which is felled in winter.

Timber or Forest Species.

Cupuliferæ. Nat. Sys.

BEECH-TREE. FAGUS.			
Monœcia Polyandria. Linn.			
Common.....	*sylvática* ...	Britain ..	70

Species for Ornament, &c.

BEECH-TREE. FAGUS.		Native of	Ft.
Var. Purple.....	*purpúrea* ..	Germany .	30
„ Golden striped leaved.....	*fóliis áureis*		
Copper-leaved....	*cúprea*.....		
Broad-leaved.....	*ferrugínea* .	N. Amer..	40
White.....	*sylvéstris*...	——	30
Fern-leaved.....	*comptoniæfól.*	——	

Cupuliferæ. Nat. Sys.

Eng. Name.	Bot. Name.
CHESTNUT.	CASTANEA.

Monœcia Polyandria. Linn.

MALE FLOWER—*ament*, naked; *calyx*, naked; *corolla*, five petals; *stamina*, ten to twenty. FEMALE FLOWER—*calyx*, five or six-leaved, muricate, or covered with soft spines; *corolla*, none; *stigma*, pencil-shaped; *seeds*, nuts, three, ovate, three-sided, enclosed in a roundish capsule, covered with soft spines.

Time of sowing the seeds—February. *Soil*—A rich sandy loam raises the chestnut to the greatest perfection as a timber-tree; but it appears to come to great maturity in clayey soils, if free from stagnant moisture. It will thrive also in gravel or sand, if not in too bleak or exposed a situation. *Uses*—The timber of the *castanea vesca*, or sweet chestnut (see page 9, *fig. e*), is said to be equal to that of the oak. For underwood or shelter, in a favourable climate, there can be no doubt of its great value, affording a fall in every ten or twelve years for hop-poles, hoops, &c. The chestnut, if not originally a native of Britain, has at least been long naturalized in the climate. The most ancient tree of this species on record is probably that mentioned by Bradley* in Lord Ducie's park, at Totworth, Gloucestershire. He states that, in 1150, it was styled the great chestnut of Totworth; and that, in 1720, it measured fifty-one feet in circumference at six feet from the ground. The same tree is mentioned, in 1791, by Lysons, who etched two views of it. This chestnut, it is highly probable, had lived a thousand years, and hence we may conclude its long duration in the soil. At Buckland, the seat of Robert Throckmorton, Esq., M.P., are to be seen some remarkably fine specimens of this tree; in several places in Kent, and on the banks of the Tamer,

* Gentleman's Magazine for 1766, p. 321. See also Martyn's Miller's Gard. Dict.

in Cornwall, all evincing the great perfection to which it arrives on a sandy, gravelly, or clayey loam. The wood, as already mentioned, is considered to be of equal value to that of the oak, and is applied to the same purposes: opinions, however, vary on the subject, and it is probable that the conclusions drawn from the supposed facts of the wood of the chestnut being found sound in very old buildings, are liable to some degree of doubt, inasmuch as a decisive proof of such wood being chestnut and not oak does not appear to have been brought forward. We have at pages 8 to 11 pointed out a certain means of identifying the wood of different species of trees. The value of the bark of the chestnut for tanning is inferior to oak bark, and the tree is not so hardy: with these deductions, and they are considerable, the two species of trees may be considered of equal interest to the planter. The value of the chestnut for coppice wood for the produce of hop poles, is well known. The varieties of the common chestnut mentioned below are very ornamental trees. The American chestnut differs but little from the English. It is most common in the mountainous districts of the Carolinas and of Georgia, and it does not appear beyond the 44th degree of north latitude. It flourishes, Michaux states, on the sides of mountains, where the soil in general is gravelly. The nuts are smaller and sweeter than those of the European species, and are sold at three dollars per bushel in the markets of New York, Philadelphia, and Baltimore. The wood is thought to be inferior to the European species. In France that of the common chestnut is held in high esteem for coppice wood: it is cut every seven years for small hoops, &c.; at fourteen years for large hoops, and at twenty-five for posts and light timber. Land so occupied, it is stated, yields a rent superior to that under other kinds of crops in the proportion of four to one. The Chincapin chestnut is not otherwise remarkable than for the beauty of its foliage and the diminutive size of its fruit.

Timber or Forest Species.

CHESTNUT.	CASTANEA.	Native of	Ft.
Sweet or Spanish.	*vésca*	England.	50
American	*Americána*	America	—

Species for Ornament, &c.

CHESTNUT,	CASTANEA.	Native of	Ft.
Var. Gold-striped	*vésca*	England?	50
„ Silver	——	——	—
„ Fern-leaved	——	——	—
„ Shining-leaved	——	——	—
„ Dwf. or Chincapin	*púmila*	N.Amer.	—

PLATANEÆ. *Nat. Sys.*

Eng. Name.	Bot. Name.
PLANE-TREE.	PLATANUS.

Monœcia Polyandria. Linn.

MALE FLOWER—*ament*, globe-shaped; *calyx*, none; *corolla*, scarcely perceptible; *anthers*, growing around filament. FEMALE FLOWER—*calyx*, ; *ament*, globular; *corolla*, many-petalled; *stigma*, recurved; *seed*, roundish, with a foot-stalk, terminated by an awl-shaped style, with a capillary pappas at the base.

Time of sowing the seeds—immediately after they are ripe, in a moist, shady situation, or by layers and cuttings in March. *Soil*—This tree prefers moist loam, but free from stagnant moisture. *Uses*—Except for fuel, the timber appears to be of little value. The trees are admired for their beautiful shade. The oriental plane is hghly praised by ancient writers. Ælian and Pliny extol it for the magnitude of its growth and beauty of form. It is generally believed that this tree was introduced into England by the great Lord Chancellor Bacon, although its introduction, according to Turner's Herbal, is set down as in 1562, or one year before the birth of that illustrious man; one thing is certain, that his plantation of it at Verulam first brought this tree into public notice. Its culture of late years has fallen into disrepute from the inferior quality of its timber. The American plane, or button-wood, is also a tree of large growth. Michaux measured one on the banks of the Ohio, whose stem, at five feet from the ground, gave forty-seven feet in circumference. This tree being more tender, or liable to be injured by the late spring frosts, has been sparingly planted of late years in England, and its wood is not of more value than the former.

Timber or Forest Species.

PLANE-TREE.	PLATANUS.		
Oriental	*orientális*	Levant	50
American	*occidentális*	N.Amer.	70
Spanish	*acerifólia*	Levant	

Species for Ornament, &c.

PLANE-TREE.	PLATANUS.	Native of	Ft.
Wave-leaved	*cuneata*	Levant	50

Eng. Name.	Bot. Name.
SWEET GUM-TREE.	LIQUIDAMBER.

MALE FLOWER—*ament*, conical, common; *calyx*, or *involucre*, four-leaved; *corolla*, none; *filaments*, numerous. FEMALE FLOWER—*calyx*, in a globe, four-leaved; *corolla*, none; *styles*, two; *capsules*, two, enclosed at the base by the calyx, one-celled; *seeds*, many.

Time of sowing the seeds—Spring, in pots or boxes of light earth; to be shaded during summer, and protected from severe frost in winter: may be propagated also by layers. *Soil*—It will succeed best in a sandy loam, but will thrive in most kinds of soils of an intermediate quality between moisture and dryness. *Use*—Ornamental.

Species for Ornament, &c.

SWEET GUM-TREE.	LIQUIDAMBER.		
Maple-leaved	*styraciflóra*	N. Amer.	30
Oriental	*imbérbe*	——	—

CONIFERÆ.

Subordo Taxineæ. Nat. Sys.

MAIDENHAIRED-TREE.	SALISBURIA.

Monœcia Polyandria. Linn.

MALE FLOWER—*ament*, naked, filiform; *corolla*, none; *anthers*, incumbent, deltoida; FEMALE FLOWER—solitary; *calyx*, four-cleft; *seed*, a drupe with a triangular shell. Propagated by cuttings.

Time of sowing—Propagated by layers. *Soil*—A sandy loam. *Uses*—Habit of growth and ornamental foliage.

Species for Ornament, &c.

Maidenhair-tree	*adiantifólia*	Japan	20

YEW-TREE.	TAXUS.

Diœcia Monadelphia. Linn.

MALE FLOWER—*calyx*, none, except a four-leaved perianth like a bud; *corolla*, none; *stamina*, many; *anthers*, buckler-shaped, eight-cleft. FEMALE FLOWER—*corolla*, none; *style*, none; *seed*, ovate, oblong, projecting with its apex beyond the berry, which is seated in a globular cup.

Time of sowing seeds—Autumn, as soon as they are ripe. *Soil*—Sandy loam; but it will also grow in most kinds of soil, particularly such as are chalky. *Uses*—Hedges for shelter. The wood is used by turners, inlayers, and cabinet-makers. It is much valued for flood-gates for fish-ponds, axletrees, cogs of mills, &c., bowls, wheels, and pins for pullies, and by turners for spoons, cups, &c. It has been disputed whether the yew is poisonous or not: the facts, however, in confirmation of the poisonous nature of the whole plant are too numerous to admit of rational doubt, and, consequently, great caution should be employed in planting it out of the reach of the more valuable domestic animals. That the berries have been eaten in very small quantities with impunity seems to be admitted; and also that sheep and goats, according to Linnæus, are less affected by taking it into the stomach, than horses and cows. The yew is a native of Britain, as well as of other parts of Europe, of North America, and Japan. The yew tree was formerly what the oak now is, the basis of our strength, for of it the old English yeoman made his bow,* as he now makes of the oak his seventy-four gun man of war.

The number of remarkable yew trees in different parts of the country are very interesting; and how much more so would they be rendered, had we records of the periods when they were planted! but we must, from want of space, refer the reader to Evelyn, Gilpin, Barrington in Archæologia. vii., xlviii., and liii., and to Martyn's Edition of Miller's Gardener's Dictionary on this point.

Species for Ornament, &c.

YEW-TREE.	TAXUS.	Native of	Ft.
Common	*baccáta*	Britain	20
Var. Striped-leaved			
Upright or Irish	*Hibérnica*		——

Eng. Name.	Bot. Name.
JUNIPER-TREE.	JUNIPERUS.

Subordo Cupressinæ.

MALE FLOWER—*calyx* of the ament, a scale; *corolla*, none; *stamina*, three. FEMALE FLOWER—*calyx*, three-parted; *petals*, three; *styles*, three; *pericurp*, or covering of the seed, a fleshy berry, irregular with the three tubercles of the calyx; *seeds*, three, bonelike, convex on one side and cornered on the other, oblong-shaped.

Soil—Light, silicious, sandy soils. *Uses*—The common juniper-bush is esteemed for its beauty as a shrub, and

* Gilpin's Forest Scenery, vol. i. p. 92.

likewise for its berries, which are used by distillers and rectifiers of ardent spirits. The plants are useful for ornament, when planted by the margins of woods. The red cedar, *Juniperus Virginiana*, attains to the size of a timber tree in deep sandy loam soils. In that part of Woburn Abbey Park called the Evergreens, said to have been planted by Miller, the celebrated author of the Gardener's Dictionary, are to be seen some remarkably fine specimens of this tree. In North America it is found wild as far as the forty-fourth and forty-fifth degrees. Michaux observes, that it becomes less common, and diminishes in size as it retires from the sea-coast. In favourable situations, as in the middle of small islands, and on the borders of the narrow sounds that flow between them and the main, it is forty and forty-five feet in height, and twelve or fourteen inches in diameter. The wood is fragrant and fine grained, strong and durable. In America, the wood is not plentiful, and is reserved for those more important purposes for which these properties are most required.

The white cedar* grows naturally in wet grounds in the marine lands of Maryland, Virginia, and New Jersey. There it attains to seventy and eighty feet in height. The wood is lighter than that of the red cedar, and is less durable. It is of slow growth in England, and even in its native soil, for Michaux counted two hundred and seventy-seven annual growths in a stem only twenty-one inches in diameter. The wood is fabricated into pails, wash-tubs, and churns.

Specise for Ornament, &c.

JUNIPER-TREE.	JUNIPERUS.	Native of	Ft.
Spanish	*thurifera*	S. Europe	
Tall	*excelsa*	Siberia	20
Red cedar	*virginiana*	N. Amer.	30
Savin	*sabina*	S. Europe	
Var. Striped-leav'd	*variegata*	——	
,, Tamarisk-lvd.	*tamariscifolia*	——	
Daurian	*daurica*	Dauria	
Common	*communis*	Britain	
Var. Swedish	*suecica*	N. Europe.	
,, Brown-berried	*oxycedrus*	Spain	
Phœnician	*phœnicia*	S. Europe	
Lycian	*lycia*	——	

* Properly belongs to *Thuja sphæroidea of Sprengel*, but ranked here according to Willdenow, under *Cupressus thyoides*.

JUNIPER-TREE.	JUNIPERUS.	Native of	Ft.
Scaly-branched	*squamata*	Nepal	
Prostrate-Juniper	*prostrata*	N. Amer.	
Hemispherical	*hemisphærica*	Sicily.	
Oblong	*oblonga*	Armenia	
Daurian	*daurica*	Dauria	

Eng. Name.	Bot. Name.
ARBOR-VITÆ.	THUJA.

Calyx, five-parted; *petals*, five; *capsule*, three-celled; *seeds*, solitary, very smooth, obtuse at the base, mucronate, and curved inwards.

Time of sowing the seeds—Spring, or as soon as the seeds are ripe. Sow in pots filled with a mixture of peat and loam. The plants are, however, generally propagated by layers—the first sort sometimes by cuttings. *Soil*—Moist, sandy loams suit these trees best: they however attain to fine trees even in damp clayey soils, or in dry sandy soils. *Uses*—They are ornamental evergreens for the fronts of plantations. The American arbor-vitæ is the only species which comes properly under the notice of the forest-planter. The value of the wood is considerable; it is slightly odorous, very light and soft grained. In Canada, according to Michaux, it holds the first place for durability. Fences made of it last three or four times as long as those of any other species. The leaves are made into a salve with hog's lard, and used in Canada for rheumatic pains.

Species for Ornament, &c.

ARBOR-VITÆ.	THUJA.		
American	*occidentalis*	N. Amer.	25
Var. Close-branched	*densa*	——	——
Chinese	*orientalis*	China	——
Plaited	*plicata*	Nootka Snd.	
Weeping	*pendula*	Tartary	
Lucas's	*Caroliniana*	Carolina	

Eng. Name.	Bot. Name.
CYPRESS-TREE.	CUPRESSUS.

MALE FLOWER—*ament*, imbricated; *calyx*, of one scale; *corolla*, none; *anthers*, four, and sitting, without filaments. FEMALE FLOWER—*ament*, changing to a strobile; *calyx*, one-flowered; *corolla*, none; *stigma*, two, concave, points; *seed*, an angular nut.

Time of sowing the seeds—Spring, in a warm situation, or in pots, in dry light earth: to be kept in the cones until the period of sowing. *Soil*—This tree delights most in a sandy loam, but it will also thrive and grow to a considerable height in clayey soils. *Use*—Ornamental and economical, as regards the wood of the

evergreen and deciduous cypresses. The wood of the upright evergreen cypress is said to resist the attacks of worms, and all putrefaction for many years. Professor Martyn says, that the doors of St. Peter's Church at Rome were built of this wood, and which lasted eleven hundred years, or from Constantine to Pope Eugenius the Fourth's time. This tree deserves to be more attended to by the British planter than it is at present. The deciduous cypress attains to a timber size in England, although it is of slow growth. Having been hitherto planted with a view to ornament rather than to economy for timber, its merits have not been proved in England. In North America its wood is highly valued, and in Louisiana, it is said to be profitably substituted for the white oak and pine. It attains to the largest size in low, damp, or swampy soils, in the southern states, rising to one hundred and twenty feet in height, and from twenty-five to forty in circumference.

Species for Ornament, &c.

CYPRESS-TREE.	CUPRESSUS.	Native of	Ft.
Upright	*sempervirens*	Candia	20
Var. Spreading	*horizontális*.	——	—
Portugal, or Cedar of Goa	*lusitánica*	Portugal	—
White	*thyoides*	N. Amer.	
Com. deciduous	*distichum*	——	
Var. Long-leaved	*nútans*	——	
Twisting	*torulósa*	Nepal	

Eng. Name. NORFOLK ISLAND PINE. Bot. Name. ARAUCARIA.

Diœcia Monadelphia. Linn.

MALE FLOWER—*ament*, imbricated; *calyx* a woolly scale; *corolla*, none; *anthers*, ten to twelve, in the scale connate. FEMALE FLOWER—*ament*, strobile-shaped; *calyx*, one-scale, spear-shaped, leathery; *corolla*, none; *stamina*, none; *seed*, a nut, leathery, wedge-shaped.

Time of sowing the seeds—In pots as soon as obtained. *Soil*—A sandy loam, in a warm sheltered situation. *Use* — Ornamental. The Norfolk island pine is a most magnificent tree in its native climate. In England it is properly a conservatory plant. How far it may be capable of being acclimated has not yet been determined. Of the Chilian species of *Araucária*, planted in the open air, there is a fine specimen in the Royal Gardens, Kew, and one at Lord Grenville's, Dropmore. Governor King states, that he measured some of the former species in Norfolk Island, which were two hundred and twenty-eight feet in height and eleven in diameter.

The wood is white, close grained, and tough, and it appears to contain no resin. The bark, however, affords a fluid partaking of the properties of that substance. *Lamb. Pin.*

Species for Ornament, &c.

NORFOLK-ISLAND PINE.	ARAUCARIA.
Sir Joseph Banks's	*imbricáta* .. Chili
Brazilian	*braziliána* . Brazil
Norfolk Island	*excélsa* .... Norf. Isl.

Eng. Name. PINE-TREE. Bot. Name. PINUS.

Monœcia Monadelphia. Linn.

MALE FLOWER—*calyx*, four-leaved; *corolla* none; *stamina*, numerous; *anthers*, naked. FEMALE FLOWER—*calyx*, scale of the strobile two-flowered; *corolla*, none; *pistil*, none. MALE FLOWER—scales of the *ament*, buckler-shaped; *corolla*, none; *anthers*, adhering to the scales, sitting, or without filaments. FEMALE FLOWER—*calyx*, scales of the *ament*, two-flowered; *corolla*, none; *pistil*, none. *Seed**, a wing nut.

Time of sowing the seeds—March: the seeds should not be taken out of the cones until the time of sowing arrives. *Soil*—All the fir and pine tribe affect siliceous, sandy soils, but they will flourish on rocky, and comparatively barren soils, for which they are peculiarly adapted. The *firs*, *pines*, and *larches* constitute a perfectly natural genus, or family of trees. The most obvious or ready character of distinction between them is to be found in the natural arrangement of the leaves. The *firs* have the leaves solitary, or issuing from one scale or sheath on the bark of the branches, over which they are scattered. The *larches* have their leaves in tufts, or little bundles, which are deciduous, and the *pines* have from two to five leaves issuing from one sheath at their base, and have the habit of an evergreen. One property is common to all the species of this genus, that of affording resinous matter, either from the wood, bark, or cones. The property of reproducing a leading stem or branch when divided, common to all other trees more or less, is wanting in this family of trees; and hence they are

* Sir J. Smith, in Comp. H. B.

called non-reproductive trees (see p. 33.) The universal use of the wood (page 10, *fig.* o.) renders its properties and comparative value so well known as to relieve the reader from details here on that point. The species which experience hitherto has proved to be most deserving of the attention of the profitable British planter are—

The *silver fir*, which attains to the height of one hundred and ten feet and upwards, with a proportionate diameter, in this climate.—(See pages 80—89.) It is very apt, during its first stages of growth, to have its young shoots cut by the spring frosts; and this circumstance, we believe, is the cause of the great neglect of planting this valuable fir. It has already been remarked, that it takes the lead of the larch, Scotch pine, and spruce after the first fifteen years of growth, and therefore its slower progress at first ought not to prevent its being more extensively planted than it has hitherto been in every situation where the fir, pine, or larch are proper to be planted for profit or ornament.

The *Balm of Gilead* fir in habit and appearance approaches near to the silver fir, but it is evidently inferior in every respect, although a very handsome evergreen tree. These two species are often confounded together*. The leaves of the silver fir are arranged nearly on opposite sides of the branch, comb-like. The under sides of the leaves have two white lines running lengthways, which give them a silvery hue. The leaves of the balm of Gilead are shorter, blunter, and stand nearly upright, in double rows, on the upper side of the branches; while, in the silver fir, they are flattened and irregularly single-rowed. According to Michaux, the resin of this tree is collected in America, and sold under the name of *Balm of Gilead*.

The Norway spruce is considered to attain from one hundred and twenty-five to one hundred and fifty feet in height. With the Scotch pine it is said to constitute the greatest proportion of the vast woods of Denmark, Sweden, and Norway. The timber is held to be inferior to that of the Scotch pine. The latter is called red deal, and the former white deal. This tree attains to a large size on cold damp clays, situated on declivities*. The white, black, and red spruces are of inferior value to the Norway. In America the wood of the black spruce is sawn into boards, and exported to the West Indies and to England; Michaux states that they are sold at one-fourth cheaper than those of the white pine.

The Scotch pine, *Pinus sylvestris*, whether as regards its hardy habits, growing in severe climates and in soils ungenial to almost every other kind of tree, or to its value in the production of useful timber, must stand in the first rank of forest-trees. The great elevation in which this tree will grow was mentioned before at page 44. A large exportation of the timber takes place from Riga, Memel, and Dantzic to England. In the former places, according to Mr. Lambert, it is called red deal, and in London yellow deal. According to respectable authority, this species furnishes four fifths of the tar consumed in the dockyards of Europe†.

The pinaster, having an inferior timber, claims but little notice from the profitable planter; however, it will grow in situations exposed to the sea air, and is an ornamental tree.

* Silver Fir—*Leaves* solitary, flat, emarginate, pectinate; *scales of the cone*, very blunt, pressed close.

Balm of Gilead Fir—*Leaves* solitary, flat, emarginate, subpectinate, almost upright above, never flat, *scales of the cones*, when in flower, acuminate, reflex.

* The resin, which concretes on the bark after a wound, being boiled in water, and strained through a linen cloth, is then called Burgundy pitch. By boiling the resin until the water is evaporated, and by then adding wine vinegar, the substance known under the name of *colophonium* is formed.

† In 1807 tar and pitch were exported to England from the United States to the amount of 265,000 dollars. The process of extracting the tar is nearly as follows:—The wood is stripped of the sap, and cut into billets two or three feet long, and about three inches thick. A circular mound is prepared, slightly declining from the centre to the circumference, which forms a shallow ditch. The diameter of the pile is proportioned to the quantity of the wood; to obtain one hundred barrels of tar the diameter should be eighteen or twenty feet. In the middle a conduit is made to the ditch, in which is a reservoir to receive the resin as it flows from the ignited mass. The top of the mound is coated with clay, and made hard and smooth, and on which the wood is laid in rays. The pile, when finished, is twenty feet at the base, and, at eight feet in height, twenty-five or thirty feet in diameter, terminating in a cone four feet above. It is then strewed with pine leaves, and covered with earth. It is ignited at the top similar to the process of charcoal making. The fire should act slowly, so that a pile of the above dimensions should continue burning eight or nine days. Pitch is tar reduced by evaporation.—Mic., Amer. Sylva., vol. iii. p. 142.

The stone pine is more celebrated for its seed, which is eaten as a fruit, than for the value of its timber. In Italy and the South of France the seed is served up in the dessert; and according to Sir George Staunton it is known and relished by the Chinese. It is a handsome tree.

The hooked pine, *Pinus uncinàta*, is remarkable for the very high elevation of the site on which it will grow, mentioned at page 44. Those other pines belonging to this group, enumerated below, are all more or less interesting and deserving of notice; but as the facts relative to the comparative value of their timber are not yet sufficiently numerous to lead to satisfactory conclusions, we must necessarily omit any further mention of them here. The frankincense, Virginian, or pitch, swamp, and pond pines are all natives of North America. The most valuable of these in their native climate appears to be the swamp, or long-leaved pine, as Michaux terms it. He remarks, that its mean height is from sixty to seventy feet, with a diameter of fifteen or eighteen inches for three-fourths of its length. The timber of the swamp pine is extensively used in the Floridas, Georgia, and the Carolinas. It has not yet exhibited any merits as a forest-tree in the climate of Britain.

The Weymouth pine is of very quick growth in sheltered situations, and moderately moist sandy soils; but the timber is of a very inferior quality. It is extensively used in America, under the name of white pine; it is considered to have little strength, and affording but a feeble hold to nails. It is stated to reach the height of one hundred and fifty feet, and five in diameter.* It was cultivated in 1705, by the Duchess of Beaufort.

The Siberian stone or Cembra pine, is a highly ornamental species in England; but its merits for timber have not been satisfactorily determined. It abounds in the Tyrol, where the wood is preferred to common deal for flooring, wainscoting, and other kinds of joiner's work. It appears to have been confounded with the *Pinus pygmæa*, but the species are very distinct.

The *Pinus Lambertiàna* was introduced in 1827, by Mr. Douglas, collector to the Horticultural Society of London. In its native soil, the north-west coast of America, it appears to be a tree of gigantic growth, and of great longevity. See (*) p. 70.

We come now to consider the last group or section of the pine tribe, or those with leaves disposed in tufts or little bundles surrounding a bud. The first and most valuable of these is the common larch. Scarcely any species of forest-tree has received so much attention and favour from planters, in a given series of years, as this tree; and our space will not allow of the simple mention of the names of the numerous eminent individuals, who have put its real and assumed merits to the test of trial, much less enable us to detail the various facts and opinions brought forward on the subject. Its merits are stated to have been known so early as the time of Julius Cæsar, who calls it *lignum igni impenetrabile*.* It is a native of the South of Europe and of Siberia, inhabiting the sides of the mountains, in the local hollows of which it attains to the largest dimensions. The first mention of its culture in England is given in Parkinson's Paradisus in 1629; and Evelyn, in 1664, mentions a larch tree of good stature at Chelmsford, in Essex. It further appears to have been introduced into Scotland in 1734 by Lord Kames. But the merit of making known its valuable properties as a timber tree for the climate of Britain, appears to be due to the Duke of Athol, who planted it at Dunkeld in 1741. The rapid growth of these and of other trees of the same species planted successively by that nobleman, and the valuable properties of the timber of such as were felled, realized the high character previously bestowed upon it by foreign and British authors, who were followed by others, such as Doctor Anderson, Watson, Bishop of Landaff, Marshall, Professor Martyn, Nicol, Ponty, Sang,

* The quantity of timber of this species of pine which passed down the Sorel for Quebec, between the 1st of May, 1807, and the 30th of July following, was 132,720 cubic feet of square wood, 160,000 of common boards, 67,000 feet of planks two inches thick, 20 masts, and 4545 logs. It is brought to the market of New Orleans from a distance of 2900 miles. At Liverpool, in 1808, the cubic foot was 60 cents, and planks of two inches by twelve four cents a foot.—N. A. Sylva, vol. iii. p. 171.

* Harte's Essays, Professor Martyn in Mill. Gard. Dict.

and Monteith, all confirming and further extolling the valuable properties of the tree, which has induced a somewhat general belief, that the larch is the most valuable of forest-trees, even taking precedence of the oak. It is no wonder, therefore, that the larch has been planted, and largely, in almost every kind of soil; and as it is not exempted from the influence of that natural law to which every other species of tree is subject, namely, that which restricts to peculiar soils the perfect development of all the parts of their structure and successful progress of growth to the state of full maturity or perfection—in many instances plantations of it have failed in making a return of the expected advantages, inferior even to the Scotch pine, not to mention the oak, elm, and ash, of greater value on a similar soil. On soils of the nature alluded to, namely, wet clays, springy gravels, and wherever stagnant moisture could not escape, the larch, after attaining to eighteen or twenty-five years growth, gives evidence of premature decay, or a suspension of healthy progress of growth, and when felled exhibits unsound timber, commencing in the centre of the leading roots, and penetrating upwards into the body of the tree.—(See page 74.) The instances are numerous which have come under our own observation of the fact now stated; and we mention it, not with a view to detract from its intrinsic value, or to discourage its propagation, but as a caution against the indiscriminate planting of it in soils without exception or without due examination. On declivities, and even in hollows, where clays abound, but where there is also a drainage for the superfluous water, the larch we have found to attain to great perfection*. The pruning of larch and other non-reproductive trees was mentioned at page 66.

The comparative value of the red and black species of larch has not yet been sufficiently proved; so far, however, as the trials have proceeded, the opinion is greatly in favour of the common or white larch.

The Cedar of Lebanon, *Pinus cédrus*, so celebrated by the ancients for the valuable properties of its wood, such as continuing sound for a thousand or two thousand years, yielding an oil famous for preserving books and writings, destroying noxious insects, &c. has not been proved in the climate of Britain to afford timber of a valuable quality; it is also more difficult to propagate and of slower growth in its first stages from seed than the firs, pines, and larches to which it is allied: its culture, therefore, appears to have been confined in this country to parks and lawns, and doubtless there is no forest-tree that, when placed singly, or in small groups, confers such an air or impression of ancient grandeur and dignity upon a mansion and its grounds as a full grown Cedar of Lebanon. It is a native of the coldest parts of Mount Libanus, where now, according to the accounts of travellers, it is found in small numbers. Rauwolf, in 1575, saw only twenty-four sound trees and two old decayed ones. Maundrell, who visited the supposed site of this most ancient forest in 1696, could reckon only sixteen large trees, but many small ones. The largest measured twelve yards six inches in *girth* and thirty-seven yards in the spread of its branches. Professor Martyn remarks that Solomon's four-score thousand hewers must have considerably thinned the forest of Libanus. The same excellent author further observes, that we have now probably more cedars in England than are left on Mount Libanus—a fact which, when conjoined with that regarding the present state of the natural forests of America, mentioned at page 87, should afford matter for deep and serious reflection to those who have it in their power to plant land, comparatively waste or unproductive, in a judicious manner, but who hesitate thus to benefit their posterity and their country, from the fallacious impression that the natural forests of America and of the north of Europe, unrenovated, as they continue to be from the neglect of planting, are inexhaustible, and will continue to supply the wants of the civil and naval architectural sciences and arts of this country.

* Where stagnant moisture of the soil prevails, a comparatively great humidity of the atmosphere accompanies it, hence it is that the bad effects of unseasonable frosts or such as happen late in spring or early in autumn are always most severe on trees in such situations, and to which the larch is very obnoxious at that season when its shoots are in a young and tender state.

Forest or Timber Species.

First—Those with leaves solitary, scattered round the branches.

FIR-TREE.	PINUS.	Native of	Ft.
Silver	*picea*	Switz.	30—80
Balm of Gilead	*balsamica*	Virginia	50
Hemlock spruce	*canadénsis*	N.Am.	10—30
Norway „	*ábies*	N. Europe	100
White „	*álba*	N.Am.	50—80
Black „	*nigra*	——	45—50
Red „	*rúbra*	——	30—50
Dwarf	*clanbrassiliána*	——	—
Oriental	*orientális*	Levant	—
Bushy	*dumósa*	Nepal	—
Yew-leaved	*taxifólia*	Columbia	—
Purple-coned	*spectábilis*	Nepal	—
Fischer's	*pichta*	Altay	—
Douglas's	*Douglásii*	N.Amer.	—
Double balsam	*Fraséri*	——	—

Second—Those with leaves in pairs, or two proceeding from the base of a sheath.

PINE-TREE.	PINUS.		
Scotch	*sylvéstris*	Scot.	30—100
Cluster	*pináster*	S. Europe	60
Stone	*pinea*	——	40

Ornamental, or whose value as Timber-trees has not yet been ascertained in England.

Upright-coned	*púmilio*	Carniola	
Nodding-coned	*múghus*	——	
Pungent	*púngens*	N.Am.	40—60
Hudson's Bay	*banksiána*	——	60
Sea-side	*marítima*	S. Europe	40
Aleppo	*halepénsis*	Alep.	20—30
Jersey	*inóps*	N.Am.	40—50
American pitch-tree	*resinósa*	——	50
Corsican	*laricio*	Corsica	—
Hooked	*uncináta*	Pyrenees	—
Pallas's	*Pallasiána*	Crimea	—
Yellow	*lútea*	N.Amer.	—
Heavy-wooded	*ponderósa*	N.W.Am.	50
Gerard's	*Gerárdi*	Nepal	—
Crooked	*adúnca*	——	—
Roman	*Romána*	Italy	—
Siberian	*Sibérica*	Siberia	—

Third—Those with leaves varying from two to three.

Two and three-leaved	*variábilis*	N.Am.	40—60

Fourth—Those with leaves in threes.

Frankincense	*tæda*	N.Amer.	30
Virginian, or Pitch-pine *	*rigida*	——	80
Swamp	*palústris*	N.Amer.	60—70
Pond, or fox-tail	*serotina*	——	—

Fifth—Those with leaves in fives.

Weymouth	*stróbus*	N. Amer.	100
Siberian stone	*cémbra*, or *aphernoúsli*	Sib. Swit.	50—60
Lambert's	*lambertiána*	N.W. Am.	
Pigmy	*pygmæa*	Siberia	—
Bhotan	*excélsa*	Nepal	—

Leaves numerous in little bundles from the bottom or base of a sheath.

Timber or Forest Species.

PINE-TREE.	PINUS.	Native of	Ft.
Com. white larch	*lárix*	Switz.	50—80
Intermediate	*intermèdia*	Altay	
Dahurian	*dahurica*	Dahuria	

Species for Ornament, &c.

Black larch	*pendúla*	N.Amer.	30
Red larch	*microcárpa*	——	80
Cedar of Lebanon	*cédrus*	Levant	—
Indian cedar	*deodára*	Nepal	—

* Cultivated before 1759 by the Duke of Bedford Mill. Dict. Ed. 7. n. 10.

In looking over the above list of forest-trees, it may seem to require a reason for not arranging the names of the trees in alphabetical order, instead of adopting the natural system of classification mentioned at the commencement of this enumeration, at page 93; particularly as such a mode, under the circumstances of a partial selection from the whole of the vegetable kingdom, must necessarily, as there stated, exhibit a broken series of connexion between the individual families or groups of trees brought forward. The index, however, will supply this apparent inconvenience, and the advantages to the young forest-planter of being early acquainted with the affinities or natural connexions of different families and species of trees with each other, will, by a little experience in the practice of planting, be fully appreciated by him, should he even confine his examination to the structure of the seed, which is given in the botanical character of each genus or family of trees. The classes and orders of the Natural and Linnean systems, under which each genus of forest-trees stand, will also point out to him where may be found the discriminating characters of distinction of the different species, as in the Species Plantarum, or in systematically arranged

Floras, where such have been published, of the plants of different countries; and in the perusal of these, should a doubt occur, the above enumeration will show whether the tree or trees in question have been introduced into British planting. The height of the trees mentioned in the list is either such as we have ascertained by actual measurement, or have been assured of by respectable authority.

The advantages resulting to individuals locally, and to the whole community, from judicious planting, have been noticed at page 2, and subsequently in the course of these pages; and what judicious planting consists in, and what are the consequent profitable results from it, have also been pointed out by an appeal to facts obtained from culture, observation, and experience; which, if examined, can hardly fail to arrest the attention of those who have given little of it to this important subject, but who, nevertheless, possess the means thus to enrich their landed possessions in their own life-time, benefit their posterity, and their country. But it is not planting judiciously at first, it has been shown, that will accomplish those important results, without the essential addition of subsequent attention to skilful culture and management of the plantations throughout the entire progress of the trees to maturity, according to the purposes for which the produce of individual trees or species of trees are most valuable, and consequently their proper period of duration in the soil; these important points have been dwelt upon, and frequently urged in the course of these pages (16, 32, 61, 64, 66, and 45, 50, 67, 68, 71); and it may be here added, that there is more absolute loss to individuals who possess plantations, but who neglect the application of judicious culture to such, than accrues from the like neglect of the healthy progress of any other agricultural crop whatever. Besides, it is an evil, that this neglect leads to an erroneous opinion of the utility, and important private and public value of judicious planting, and induces many who have it in their power to plant extensively to omit it, and leave that land barren and waste, which might otherwise be so beneficially occupied in the growth of timber, and amelioration of defective local climates. The great extent of waste-land in this kingdom has been stated at page 85.

By referring to the county surveys, and to other sources of information, it will be found that a large portion of the waste, or comparatively unproductive lands, in this kingdom, is capable of being profitably employed in the growth of timber; and, taking the proportion of one-twentieth part only of the whole, there will be upwards of three millions and a half of acres available for the purpose, or say, one million and a half of acres for trees, and two millions of acres for conversion to down-pasture, or partly tillage, by the aid of the shelter and amelioration of the local climates produced by the judicious disposition of the plantations. The facts and observations brought forward in evidence of the public necessity for the extension of forest-tree planting, as well as the advantages accruing from it to private estates, need not here be repeated; neither need it be recalled to mind, that the perpetual consumption of timber from the natural forests of this country, without any aid being afforded in return to renovate or keep up a succession of trees by planting, at last caused that scarcity of timber for civil and naval architecture which first led to the culture of timber-trees as an article of profit, and which has brought the art of arboriculture to a higher degree of perfection in Britain than in any other country. But a similar consumption without renovation is now going on in those countries from which we fallaciously expect an inexhaustible supply of timber; and we cannot but press upon the attention of those in whose power it rests, and whose duty it is to provide more largely for posterity than our ancestry has provided for us, that with the more perfect knowledge now possessed of the art of planting, the large extent of fit, but unoccupied soil, and the superabundance of unemployed labourers, to effect the work to its fullest extent,—this important object ought to be forwarded with that zeal, energy, and skill, which have been already displayedby some few individuals, and have been uniformly attended with success.

ORNAMENTAL PLANTING.

In the preceding parts of this treatise we have confined ourselves almost entirely to planting for profit, and have merely enumerated with brief remarks those trees, which, though incapable of being cultivated with advantage in our climate for economical purposes, produce striking effects in landscape scenery, and are of great value in the adornment of parks and pleasure grounds. They are not for the most part scarce in the nurseries of Great Britain, yet as we have observed that the planting of exotic trees is comparatively neglected, a few pages may be not unprofitably occupied, in pointing out such as seem peculiarly deserving of attention.

The beauty of English park scenery is universally admitted: the constant source of fresh admiration to foreigners, and of delight to ourselves, it may, perhaps, be briefly described, as the art of imitating, in small compass, the most lovely scenes of external nature. In a pursuit so fascinating, the most elegant mind may find amusement, the most active benevolence room in which to dilate. In eliciting from crude materials new forms of beauty; in opening the valley; converting the barren hillside into wood; in expanding the lake, and clothing a once naked district with luxuriance, the worth of an estate is increased, health improved, and charity the most useful dispensed, for

> 'Hence the poor are clothed, the hungry fed,
> Health to himself, and to his children bread,
> The labourer bears.'

The general practice cannot be much improved, but some beauties of detail may be gained, by a more frequent employment of foreign vegetation. Every one is aware of the charming effect of the weeping willow: this is a case in point. The light ramifications of the Robinia contrast beautifully with the bolder form of the oak; the hiccory, or black American walnut, relieves the heavy masses of the elm; the lucid green of the Spanish chestnut is well opposed to the dinginess of the beech; and the brilliant tints of many North American trees when in decay add a new and remarkable feature to the autumnal landscape. But the interest arising from the adoption of foreign trees into domestic scenery is not confined to their picturesque effects. They remind us of the climes whence they come, of the scenes with which they were associated. In exploring a well-selected arboretum, the eternal snows of the Himalaya, the savannahs of the Missouri, the untrodden forests of Patagonia, the vallies of Lebanon, pass in review before us: we seem to wander in other climes, to converse with other nations.

Although few foreign trees become permanent with us, many bear our climate well, yet, tried by the test of spontaneous propagation seem not to be capable of perfect naturalization. No genus is of more frequent occurrence in England than the hardy lime-tree, of which at least three nearly allied species inhabit the continent. In European Russia they abound, and supply the bark from which the mats so largely used in our gardens are made. Here, though with attention the lime may be raised from seeds, nothing is rarer than to meet with a spontaneous seedling, even near individuals of great size, covered with myriads of seeds, mature, but, by some unsuitableness of climate, bereaved of competent vigour

to rear themselves unaided by art. The common *English* elm, (Ulmus campestris,) which peoples the hedge-rows of our southern counties, rarely perfects its seeds in England, and propagates itself by suckers. So near to us as Paris, it finds a congenial climate, and ripens them plentifully. The horse-chestnut, a native of the mountain-chains of Asia Minor, tried by the same test as the lime-tree, that of spontaneous propagation from seeds, appears to be one of the few instances of an exotic tree perfectly acclimatized in England. Perhaps another instance may be found in the Turkey oak, (Quercus cerris,) and some cases exist among coniferous trees. But though the laws of nature forbid us to hope for the perfect naturalization of many trees of other climates differing but little from our own, they allow us to embellish our domains with the rich variety resulting from the elegance of their forms, and the diversity of their tints. We have already alluded to the tree usually called the Turkey oak, (Q. cerris,) a native of the middle elevations of the Papal states, Tuscany, and southern Italy: it is always distinguished by the Italian writers from the common oak, (Q. robur,) as the *cerro*. About the lake of Perugia, and the scene of the memorable battle of Thrasymene, it attains to enormous bulk, and is very picturesque in its form, though its branches are not so abrupt and angular as those of our native oaks. In England it seems to be perfectly at home, grows fast, and produces abundance of acorns, bears bleak exposures, and thrives in lighter and more silicious soils than suit the oaks of England. It retains its leaves far into the winter, a valuable property when shelter is desirable. There is, perhaps, cause for apprehending that it will not thrive so well in a confined or crowded, as in an airy situation. Mr. Atkinson, the eminent architect, having converted a specimen of good size, which he found at the seat of the Marquis of Downshire in Berkshire, has proved experimentally its valuable properties for ornamental purposes in domestic architecture. Its wood is closer in its grain, bears a higher polish, is richer in colour, and more varied in its markings than the wood of our indigenous oaks, or that which is brought down the Rhine from the forests of southern Germany, and imported into this country by the name of wainscoat oak, being, in point of fact, the produce of the Q. robur, and Q. sessiliflora, and owing its peculiarities to a more rapid growth in a more genial climate. We cannot too strongly recommend this beautiful and fast growing tree to our readers, combining as it does beauty of form, rapidity of growth, and much indifference about its soil, with a constitution of singular hardihood. We have seen it thrive in exposures where our own native oak and beech became stinted. A sub-variety of the Turkey oak, or more probably a distinct species, is known in the nurseries by the name of the Fulham oak, (Q. dentata, page 111,) after the parent tree, a magnificent specimen, now growing in the nursery ground of Messrs. Whitley and Co. at Fulham: it is highly deserving of cultivation. The Luccombe oak, supposed by some to be a hybrid production between the Turkey and Cork oaks, but more probably an indigenous Spanish species, is a pyramidal tree, apparently of moderate growth, and almost an evergreen. The Cypress oak, (Quercus fastigiata, page 111,) a native of the Pyrenees, and of the mountains of Portugal, resembles the English oak in leaf; but is of habit probably unique in this genus, carrying all its branches upright like a Cypress or Lombardy poplar, a circumstance of some value in landscape planting. Q. tauza or toza, the Chêne taussin of the French, indigenous to the *landes* of Bourdeaux and sandy soils of the south of France, is of low growth, with a very indented leaf, pubescent on its under surface; it is said to trace much from its root.

The ornamental qualities of the ilex are universally appreciated; the cork-tree, whose singular beauty of form and foliage are the admiration of all travellers in southern Spain, too tender to thrive except in a few favoured spots in our southern counties, is sufficiently described in the list of forest-trees, (page 111.) But the oaks of North America claim the deepest attention from the ornamental planter. Ranging through many degrees of latitude, and growing at very different elevations, consequently under much variety of climate, some of them are hardy with us, some tender; but all abhorrent of wet or clayey soils. Deprived of the cloudless sun and high temperature of an American summer and autumn, they cannot ripen their shoots sufficiently to be frost-proof, except upon soils of a light and warm nature. Their foliage is beautiful, frequently singular: with the effect of their autumnal tints of crimson every British tree fails in comparison. We shall only advert to such of those described by Michaux and Pursh, as we believe to be calculated to succeed in this country. In the garden of the Pêtit Trianon, at Versailles, the favourite retreat of the ill-fated Marie Antoinette, a fine specimen of the willow-leaved oak, (Q. phellos,) is very ornamental; it is not unusual in sheltered villa gardens in the neighbourhood of London, but in an inland situation in Hampshire, elevated about 600 feet above the sea, its shoots have been killed every winter. Q. humilis, maritima, sericea, cinerea, (Pursh,) are all related to Quercus phellos, and probably tender. Q. imbricaria is hardy and very deserving of notice, on account of its beautiful, shining, almost entire leaves, little resembling the familiar appearance of the oak. Q. tinctoria, discolor, coccinea, alba, rubra, montana, olivæformis, all hardy upon light soils, all attaining to large size, all beautiful in their perfect foliage, are superb during its decay. Q. tinctoria, one of the largest and finest trees of the North American forests, produces the valuable material so well known in commerce as quercitron bark. An oak of great size and promise, with fine broad leaves, and immense acorns, (Q. macrocarpa,) was introduced by the late Mr. Lyon, from the state of Tenessee. We have seen it only in the high situation in Hampshire before mentioned, where it has been unable to ripen its shoots. Most of the oaks enumerated by Michaux, as varieties of Q. prinos, but by Pursh as distinct species, must be tender in England, except under very favourable circumstances; perhaps by grafting them upon the Turkey oak, thus furnishing them with roots of hardier constitution than their own, their shoots may be ripened with greater certainty. The oaks of Spain, upper Italy, Croatia, Bosnia, and Turkey, are very imperfectly known; some of them are allied to Q. cerris, but are sufficiently distinct to make it desirable that we should possess them. Mr. Walsh, in the Transactions of the Horticultural Society of London, vol. vi., describes an oak growing near Constantinople, (Q. pubescens,) as a fine and beautiful tree; its leaves covered with down beneath, and its branches when young, pendulous, like those of weeping willows. It is probable that interesting species exist in the unexplored and classical regions of Asia Minor, now by the advancing civilization of the Ottomans, and the improvement in their government, laid open to the researches of travellers. But by far the most curious additions to our oaks, perhaps to the arboretum generally, are to be derived from the mountains of the Himalaya. We earnestly invite the attention of individuals connected with India, to the vegetable treasures of this region; whose valleys, more elevated above the sea than the top of Mont Blanc, contain within their bosoms most interesting species of oak, birch, walnut, fir, cedar, and other genera of cold climates, calculated by their beauty to adorn our parks and gardens in the highest degree. Some

of these have been made known to us by the active researches of English botanists. Q. grandifolia, with immense shining leaves, equalling those of Magnolia grandifolia in size and texture, has been figured in Mr. Lambert's splendid work on the genus Pinus. Q. spicata, with entire leaves from six inches to a foot long, and acorns numerously crowded upon an upright spike from ten to eighteen inches in length; Q. lamellosa, with firm leathery leaves, smooth and glossy above, mealy and nearly white beneath, sometimes a foot in length, and as much as five inches in breadth, are both figured in Dr. Wallich's magnificent work, the Plantæ rariores Asiaticæ, now in course of publication, and we hope of encouragement, commensurate to its extraordinary claims upon every lover of natural history.

The coarse foliage of the elm, in our opinion, degrades it from the first class of ornamental trees, but in some situations, particularly in deep and somewhat damp soils, it succeeds better than many, and grows to vast size. Its varieties are curious—the variegated leaved elm is not without merit—the weeping elm is sometimes picturesque—the small leaved Cornish elm is perhaps the most elegant. The American elms seem to be deserving of attention. Mr. Hodgson, a recent traveller in the United States, was much impressed with the stupendous stature of specimens of the ulmus Americana around the neat villages of New England.

The giant bulk and extraordinary beauty of the oriental plane tree (Platanus orientalis) have made it, in all ages, the object of marked attention. Every classical reader is aware of the favour with which it was regarded by the Greeks and Romans, the latter of whom, according to the Latin writers, carried their admiration of this beautiful tree so far as to occasionally irrigate it with wine. Hardly less beloved by the Turks in modern days, it is with them a usual practice to plant one at the birth of a son. In the court of the Seraglio, as we are told by Mr. Walsh, is a venerable specimen, planted by Mahomet the Second, after the conquest of Constantinople, in commemoration of the birth of his son Bajazet the Second; it is now fifty feet in girth, the increment of three hundred and seventy years. At Buyukdéré, on the Bosphorus, is another of almost unequalled size: it stands in a valley, and is forty-five yards in circumference, but, in fact, now consists of fourteen large trees, growing from the same root-stock, coalescing near the ground, but, at some distance from it, diverging into distinct trunks. The oriental plane is indigenous throughout Asia Minor, ranging to a considerable elevation, but attaining its greatest size upon low levels and in deep soils. The specimens, whose remarkable bulk has conferred upon them an almost historical notoriety, are all situated not much above the level of the sea. In England this tree is perfectly hardy, and of the first beauty. It is remarkable, that though introduced here three hundred years ago, under the auspices of Lord Chancellor Bacon, it has been comparatively neglected since the introduction of the North American plane (Platanus occidentalis), which, being propagated with much greater facility from cuttings, has long been in almost undivided possession of the nurseries. Much inferior to the Oriental in beauty of leaf, though, according to American writers, not in size or majesty, the occidental plane, which attains its utmost luxuriance in the warm valleys of the Ohio, and upon the limestone soils of Kentucky and Tenessee, has proved incompetent to contend with our spring frosts, our sunless summers, and our clouded autumns. About twenty years ago, a great proportion of all the individuals in England, without respect of age or bulk, were killed outright by a late spring frost. Since then we have seen them repeatedly injured, and, when half recovered by the

operation of a summer of more than average warmth, again replunged into the same state of debility, whilst the oriental plane has remained quite uninjured. The intermediate species (P. cuneata, P. acerifolia) seem to be hardier than the American plane, but less so than the oriental plane.

Another American tree, of large stature, high beauty, and hardihood, is the tulip tree (Liriodendron tulipifera), which, as its name imports, unites the charm of abundant pale yellow flowers, bearing some resemblance to tulips, with beautiful broad leaves, of very ornamental form and colour. When placed near the American oaks, its foliage contrasts with them finely, particularly when, in autumn, it opposes its yellow tint to their shades of crimson. It is perfectly hardy, and becomes a large tree in England when planted in dry and deep soil.

Though our principal object is to treat of exotics, yet we cannot avoid mentioning the lime-tree, one of our most stately forest trees. Naturalists decide that three species are natives of England; but that which has the fairest pretensions to be so considered, according to the authority of Sir James Smith, Tilia parvifolia, is far less common in parks, than its congeners, though, in our opinion, it excels them in beauty. The North American species are very soft-wooded trees, and, in this country, of small stature: we have observed a very extensive gangrene, sometimes extending several inches down the trunk, to follow frequently upon the amputation of one of their branches, even of moderate size. They deserve little attention, except perhaps Tilia heterophylla, introduced about twenty years ago by Lyon, the industrious collector. Tilia alba, said by some to be a native of Hungary, a round-headed, thickly branching tree, of rapid growth, and somewhat formal outline, with broad leaves, green on their upper, and white on their lower surface, an attribute well displayed when they are agitated by wind, possesses the merit of being almost the latest deciduous tree to drop its leaves at the approach of winter.

We briefly advert to the Spanish chestnut, so superb in its stature, in one memorable instance, in this country, reaching to a girth of above fifty feet*; so beautiful in its foliage, so stately in its maturity, so venerable in its age, so rapid in its progress on warm gravels or deep fertile sands, together with its elegant variety the fern-leaved chestnut of the nurseries, and pass on to that delightful exotic, whose tumid bud is the well-known harbinger of spring, whose magnificence is perhaps undervalued, because it meets us in every walk, the horse-chestnut, the Æsculus hippocastanum of botanists. A species nearly related to it, if indeed it be not a mere variety, Æsculus rubicunda, with fine red flowers produced apparently in great abundance, should be universally planted. It has been lately introduced, along with Æsculus rosea, of nearly equal beauty, from the continent, where greater attention appears to have been paid to trees than in this country. Æsculus flava and neglecta, with flowers of but moderate beauty, are elegant in foliage and habit; the flowers of Æsculus Pavia are high coloured, though small; several other hardy species are rather shrubs than trees. But all of them deserve distinguished places in the arboretum or garden, and should, if possible, be raised from the nut. Generally they are propagated by budding upon the common horse-chestnut—an operation of great facility; but, in such case, the stock is apt to swell in a ratio much greater than the graft, becoming, not only unsightly, but rendering the specimen short-lived.

The whole genus Betula is ornamental, yet perhaps the most beautiful species it contains is our common birch (Betula alba), and its variety or kindred species, the weeping birch. These trees are of much too rare occurrence in park scenery; they are picturesque in outline, light

* Vide page 117.

in foliage, silvery in bark, very effective when disposed in groups, and contrasting finely with the heavier forms of our native larger trees, but, like almost all trees of small growth, too apt to be neglected. The American species exceed them in size, but are inferior to them in elegance. They are nevertheless most interesting trees, and should be in every collection. With their tough bark, which is readily detached in large sections, the North American Indians roof their houses, and manufacture a variety of domestic utensils. Of it are formed those light canoes which float the Canadian over the vast lakes, or down the rapid rivers of his native regions, at one moment bearing along the trader, his valuable cargo, and adventurous companions; at the next moment carried upon their shoulders across the intervenient portage. It is not too much to say, that, without the assistance of this invaluable material, the fur trade would have been confined within narrow limits instead of pervading half a continent; and the progress of geographical discovery, the long labours of a Hearne, a Mackenzie, and a Franklin, would have been incomplete for another century.

A near relation to the birch is the neglected alder, neglected because common, and rarely seen, except in the shape of coppice-wood, yet reaching, in favourable situations, to a size not generally suspected. At Gordon Castle, in Bamffshire, some exist of extraordinary stature, when seen at a distance, having much the appearance of oaks. Three of them, which are described by Joseph Sabine, Esq., in the Seventh Volume of the Transactions of the Horticultural Society of London, measured, one, seventy-one feet high and nine feet four inches in girth; one, sixty-one feet and a half high and seven feet four inches in girth; and another, fifty-eight feet high and eight feet in girth, the girth being taken at five and six feet from the ground. To those who wish for trees capable of enduring abundant moisture, we recommend the cut-leaved alder (Alnus glutinosa, var. laciniata) a derivative apparently of equal size, and of growth as rapid as its type, which it greatly excels in elegance; several other curious varieties of the common alder are to be found in the nurseries. Alnus quercifolia is probably of smaller growth, and the habit of Alnus oxyacanthifolia appears to be feeble; but Alnus cordifolia of southern Italy is a fine ornamental and hardy tree. There are some other species, rather shrubs than trees, which may be used advantageously in moist localities, where a low growth of definite height is desirable.

We attribute the comparative disuse of the common ash in park scenery, and its rare occurrence as an insulated specimen, to the extreme avidity with which it is attacked and barked by deer, those enemies of the planter. Yet it is a tree of singular elegance, both in itself, and contrasted with trees of heavier foliage: it grows to immense size, attains to great longevity, and when old is strikingly picturesque in outline, in bark, and in the almost horizontal disposition of its main branches. The entire-leaved ash (Fraxinus simplicifolia) is an interesting variety; the weeping ash (F. excelsa, var. pendula) is well known, yet hardly enough appreciated. When large, it is remarkably beautiful, but it must be planted in an inclosed spot, free from the approach of cattle and sheep, who, by browsing upon its pendulous branches, would destroy the whole beauty of the specimen, and irretrievably check its growth. Fraxinus ornus, the flowering ash, is a beautiful small tree, especially in early spring, when in flower. Fraxinus lentiscifolia is a charming small tree; most of the American ash are fine in foliage, and deserve a trial in the arboretum. Many of them exist in the Jardin des Plantes at Paris, where they cannot fail to attract the attention of any person interested in forest trees.

The common walnut—disfigured in England by spring frosts, coming late into leaf, and losing the whole beauty of its foliage prematurely in autumn—cannot be termed picturesque here, whatever it may be in the warm valleys of Switzerland and Upper Italy; but we hardly know a more picturesque tree than the black American walnut (Juglans nigra), which, in North America, is one of the most stupendous inhabitants of the forest. It is quite hardy, and of moderately quick growth, but certainly possesses the fault with which we have just reproached the common walnut, of tardy leafage in the spring. Its pinnated foliage is much more dense and tufted and of a livelier colour than that of the common ash. With the remaining American species we are not acquainted, but it would appear, from the statements of travellers, that none of them are trees of great beauty.

Several species of MAPLE claim the attention of the ornamental planter; a few are large trees; the greater portion are of small growth, and upon that account are, in our opinion, of great value in the creation of park scenery, where the object being to produce much effect in moderate space, it is frequently desirable to impart artificial height to small elevations, by crowning them with high trees, and, at the same time, to occupy the low grounds and middle distances with trees of humbler stature. It is in this point of view that the genus Maple, of which we are treating, is of importance. The common maple (Acer campestre) is rarely planted, and comparatively unknown as an ornamental tree, though few objects are more beautiful than it is when old, and arrayed in its bright yellow autumnal livery. The Norway maple (A. platanoides) excels the common maple but little in height, and is rather remarkable for its sturdy formal character. In early spring, just before the appearance of its leaves, it is covered with a multitude of yellow flowers; in autumn, when in incipient decline, few trees can contend with it in beauty; its leaves assume decided but various colours, singularly effective, owing to the distinct masses in which they are apt to arrange themselves. Whilst the greater part of the tree remains green but little faded, a whole branch suddenly becomes dull red, then another mass bright yellow, a tint which, gradually creeping over the whole foliage, is the forerunner of its fall. The ash-leaved maple (A. negundo), somewhat loftier than the Norway maple, and not possessing its formality, requires especial notice. Hardy, free growing, and graceful, when placed, as we are in the habit of seeing it, near trees of sombre hue, the very vivid green of its light foliage stands out distinct and brilliant, offering one of the best examples of the great beauty to be attained, by bringing into contrast trees of different tints. Several of the American maples are beautiful small trees; the sugar maple is of large growth, and curious from its valuable economical properties; but the most interesting species of this genus is A. macrophyllum, a huge tree, with broad leaves and most valuable dense timber, which has been lately introduced from the banks of the Columbia in North Western America, a region of stupendous vegetation, by Mr. David Douglas, the enterprising collector of the Horticultural Society of London. A. circinatum of the same country, also introduced by him, is a very handsome small tree, with deeply incised leaves, the graceful habit of which very much attracted his attention during his investigation of these countries.

The merits and demerits of the common BEECH, its peculiar adaptation to calcareous and dry gravelly soils, and the great bulk it attains upon them, its somewhat formal and little varied outline, its heavy autumnal tint, are too well known to detain us here; but we must not pass, without notice,

its curious but puny variety, the fern-leaved beech (Fagus Comptoniæfolia), nor its very remarkable variety the purple beech, whose leaves in early spring of blood red hue, in summer uniform dull purple, are too singular, (having, we believe, no parallel among hardy trees, except a remarkable variety of hazel,) not to ensure it a place in every collection. Situations may be found in the neighbourhood of ruins, or the recess of a secluded grove, where it may be employed with happy effect. We have found the North American beech not to succeed in our climate in dry calcareous soils; and they are described by Pursh as growing upon rich deep levels. Some most interesting species exist in Patagonia and in those regions, which every effort should be exerted to procure. Perhaps the greatest desiderata in British parks are evergreen trees, not being of spiral forms. The cedar of Lebanon, the evergreen oak, and the yew, begin and end our list of such. But Captain King, in his recent arduous survey of Terra Magellanica, that region of storm, of snow, and glacier, found, we believe, three species of beech in those countries; two of them he mentions by name, Fagus antarctica and Fagus betuloides. The latter, an evergreen tree of frequent occurrence, was met with in peculiar abundance in the neighbourhood of Cape Famine: trees of three feet in diameter were plentiful, of four feet there were many, and one was measured by Captain King, which maintained a girth of seven feet, as high as seventeen feet from the root, and then diverged into three immense limbs, each of them being three feet through. Live specimens of those trees were brought to England by Captain King, but have unfortunately, we hear, been lost. Every effort should be made to re-introduce objects of such interest. The true Winter's bark, (Wintera aromatica,) a native of the same inclement countries, is also an evergreen tree of small stature, but on every account interesting. It is most probable, that many important acquisitions to our shrubberies are to be found in the same regions. Fuchsias of great beauty were discovered growing to be considerable shrubs in the vicinity of perennial snows; barberries producing excellent fruit for tarts; veronicas of great size. We mention these facts, in the hope of directing attention of amateurs to these countries generally, including the southern parts of Chili, and the archipelago of Chiloe.

Pursuing our immediate subject, we must not omit to mention a very beautiful tree resembling the sumach in leaf, Ailanthus glandulosa, a native of China, which, to singular beauty of foliage, unites great hardihood. It has the defect of coming into leaf perhaps the latest of any hardy tree; but compensates in some measure for this fault by its extraordinary gracefulness. It is easily propagated by cuttings of the roots.

The Robinia pseudacacia, or locust tree, is universally known and appreciated as being singularly well adapted to garden scenery. Rapid in its growth when young, it seems to lessen its pace materially, after twenty or thirty years, apparently in consequence of its roots penetrating into a colder subsoil, and it appears to be short lived on chalk soils. We do not think it likely to become a large tree in England, except in a few very favoured spots. Its timber possesses great durability. The various species of sweet locust, or Gleditschia, are slender trees of elegant pinnated foliage, and derive some interest from the very remarkable thorns investing some of them: they are rather garden than park trees, and require deep soil, together with a warm substratum. The same remarks as to soil apply to the genus Celtis, or nettle tree. In England we have rarely met with a good specimen; in France we have seen them of great elegance.

The willow tribe affords us one exotic of pre-eminent beauty, the Salix

Babylonica, or weeping willow. It adorned the banks of the Euphrates in the days of prophecy, and has been rendered memorable by its connexion with the captivity of the house of Israel. As might have been expected from its Assyrian origin, it is somewhat tender, and in high situations is liable to be injured by spring frosts. Nothing can exceed its beauty when properly applied. Hanging over a rock, jutting from a promontory, or reclining over an urn, few objects in nature more delight the eye of taste. The common white willow, (Salix alba,) is a tree also of great beauty, but strangely overlooked, being generally degraded most unworthily to the condition of a pollard. It grows, when indulged with its favourite situation, a deep rich soil by the side of water, to a very large size; and so placed, we have seen it attract great notice by the fine contrast between its slender silvery leaves, and the dark foliage, and dense masses of the oaks and beeches which crowned the adjoining heights. Such an example is to be found on the banks of the lake at the Grange in Hampshire, the magnificent seat of A. Baring, Esq.

No other species of willow is of equal importance in ornamental planting; but the POPLAR tribe must not be overlooked. Amongst its species, the most important, as an ornamental tree, is also the one which, because it is of the most common, hacknied occurrence, has hardly escaped the reproach of vulgarity. Yet how beautiful is the spiral Lombardy poplar when judiciously used, and when, being planted in rich deep soil, and forced into something like the bulk which it reaches in its native climate, it is tastefully contrasted with large trees of rounded forms, and its clear fine green at the same time brought into opposition with their heavier tints! Next in point of ornament is the English black poplar. The aspen derives some interest from its tremulous leaves, agitated by the slightest breath of wind; the Canadian poplar from its habit intermediate between the pyramidal Lombardy poplar, and the spreading black poplar; and the Ontario poplar, lately introduced, from its very ample leaves and singular rapidity of growth. The other species are rather subjects for a general collection, and cannot be described as decidedly trees of ornament; but the very rapid growth of the black Italian poplar, which is not a native of Italy, nor a variety of Populus nigra, but an indigenous North American species, fits it, in a peculiar manner, for many purposes of ornamental planting. The hornbeam can scarcely be deemed an ornamental tree, yet, where individuals of small growth are requisite, it may be advantageously employed. Its varieties are curious in foliage, and are more graceful than their type.

The few deciduous trees which remain for us to mention are rather garden than park trees, and require every advantage of soil, shelter, and protection: among these the genus Magnolia stands pre-eminent. Three species only can be considered as trees in this climate, and one of them, (M. grandiflora,) the loveliest tree perhaps of temperate climates, whether for its lucid foliage, or its superb and fragrant flowers, though growing in its native climes to the stature of eighty feet, with us is a small tree, under twenty feet in height, not reaching even this elevation except in sheltered spots, and within the protection and reflected heat of walls. M. acuminata, a deciduous tree, not gifted, as most of its race, with showy or fragrant flowers, possesses a splendid leaf, is much hardier than M. grandiflora, and grows in England to be a larger and loftier tree. M. auriculata, strictly a garden tree, is slender in form, spiral in habit, and elegant in foliage, every branch being terminated, in a healthy specimen, with a handsome and fragrant flower. The other hardy species, except perhaps Magnolia conspicua, are rather large shrubs than trees, though, under favourable circumstances, some of them reach to considerable

height. The Himalaya contains within its recesses a noble and lofty tree of this genus, M. excelsa, magnificent in its foliage and bulk, and covered, when in bloom, with innumerable splendid flowers. Liquidamber styraciflua is a small, but interesting garden tree. Koelreuteria pinnata, a native of China, comes under a similar class; but is entitled to much consideration on account of its very elegant pinnated leaves, and feathery flowers profusely produced in warm autumns, and occasionally succeeded by ripe seeds, from which we have propagated it. The very exotic foliage of Salisburia adiantifolia, the maidenhair tree, ought to ensure to it a place on every lawn; higher claims to distinction are possessed, in our opinion, by Virgilia lutea, a small tree of peculiar beauty of form and foliage, introduced about twenty years ago, from the mountains of Tenessee, by Mr. Lyon, and still uncommon in the nurseries. It has not yet produced its elegant papilionaceous flowers in this country, though we have heard that they have been seen at Paris. We must not omit to mention an indigenous tree, which, delighting in chalky soils, should never be overlooked by any person residing upon them, the white beam, (Pyrus aria.) The whiteness of the under surface of its leaves and the wildness of its habit are valuable properties, but indifferently shared by its near relation, Pyrus intermedia. The value of the common hawthorn in park scenery, and the remarkable union which it exhibits of beauty of flower with picturesque rudeness of form, need not be dwelt upon. Its beautiful pink variety has been long known; another pink variety, of colour more intense, and scarcely to be surpassed in the loveliness of its tint, has lately made its appearance in the nurseries, under the denomination of the new scarlet Thorn. The merit of the double-flowering variety is great, uniting to luxuriance of the individual flower, equal luxuriance in their produce. Several other curious varieties of hawthorn have been collected by the Horticultural Society of London, at Fulham. Cratægus grandiflora is a valuable small tree; and many species of Pyrus, Mespilus, and Cratægus, should find room in an extensive arboretum.

We have nearly concluded our remarks upon ornamental deciduous trees: before we proceed to the Coniferæ, so important in themselves, and so interesting from the additions lately made, and still making, to their number, we shall briefly advert to the mode of transplanting large trees, so well described by Sir Henry Stewart of Allanton in his Planter's Guide, and adverted to in page 45 of this treatise. By careful observance of the precautions laid down by Sir Henry Stewart, trees of very large size may be safely transferred to new spots; but the practice is not new: it has been more or less followed in all ages. The Duc de St. Simon describes what Louis XIV. accomplished in this way at Versailles and Marly. Thirty-three years ago large and successful operations of the same nature were performed by the late Earl of Carnarvon, at his beautiful park at Highclere in Hampshire, principally upon limes, beech, and horse-chestnuts.

We have ourselves removed large trees without failure, and have seen reason to conclude, that notwithstanding the careful preparation of the tree, the preservation of its roots and rootlets, and the careful adaptation of the soil, the success of the effort, and the immediate growth of the tree, will still depend much upon its removal at the beginning of winter, and upon copious watering early in March, to be continued at least every fortnight during the first summer after transplantation, and into the second summer if the leaves shall appear to flag in warm weather.

We observed that the principal want experienced by the ornamental

planter in this climate, is the scarcity of EVERGREEN trees, not being coniferous.

The evergreen or holm oak, is, in point of fact, our only park tree of this description; though of garden shrubs there is no want. The deficiency is partially supplied by the very interesting tribe of coniferous trees. But their forms being generally spiral, they cannot contend, either singly with the bold and varying outline, the extended, tortuous limbs, the swelling masses of tufted foliage, which give to a stately deciduous tree a character of impressive grandeur; or when aggregated over a large surface, in which case, their general monotony of tint, the tameness of their lights and shadows, and the pyramidal termination of the majority of the individuals composing the mass, deprive it of much of the beauty so universally felt in woodland scenery composed of deciduous trees.

One illustrious exception to the first clause of our proposition will at once occur to many of our readers, in the CEDAR OF LEBANON (Pinus Cedrus, p. 127.) In our enumeration, we have said that no tree confers such an air of grandeur and dignity upon the grounds surrounding a mansion, as a full grown cedar of Lebanon, not only the most beautiful of the whole tribe of hardy coniferous trees hitherto known to us, but perhaps altogether the most majestic tree which can be cultivated with perfect success in Great Britain, peculiarly suited to the character of park or garden scenery, and harmonizing better than any other with architectural objects. Thinly scattered in the more elevated vallies of Lebanon, of Taurus, and of other lofty mountain chains and groups in Asia Minor, its somewhat rare occurrence is to be accounted for, probably, by a peculiarity of constitution, which renders a free circulation of air around it quite essential to its vigour. When planted in a wood, or even on a lawn, closely surrounded by other trees, it becomes thin of leaves, feeble in habit, and incapable of swelling to large size. To its full strength and beauty, it is indispensable that no check should be opposed to the horizontal spread of its branches. Even the operation of shortening its lateral shoots, for the purpose of forcing up a leader, cannot be often repeated without injuring its health. These peculiarities render it a scarce tree in a state of nature, where it is only found in elevated, but sheltered vallies, whose vegetation is subdued by the browzing of cattle. It will never abound but in the seats of civilization, and it is exceedingly probable that the parks of England can show more cedars than the whole of the wide range of its native regions. This most interesting and majestic tree is sometimes neglected, in consequence of a groundless apprehension of the slowness of its growth,—an apprehension which we shall proceed, from authentic documents, to dispel. Highclere park, in North Hampshire, the creation of the late and present Earls of Carnarvon, claims a high rank among the most beautiful domains in our southern counties. Some fine cedars of Lebanon adorn the immediate vicinity of the mansion. Their history is interesting. The lawn on which they stand, elevated about 600 feet above the level of the sea, is at the foot of the bold northern escarpment of the Chalk Downs, which rising about 400 feet above the house, extend for twenty miles to the southward. The soil is thin and sterile; the immediate subsoil hard plastic clay, with flints; its substratum chalk, not three feet from the surface. The climate is cold, foggy, windy; the spring very backward, the summer temperature low. We shall proceed to give a tabular view of the progress of the six largest trees, from authentic memoranda, to which we have been allowed access. The two oldest specimens, No. 1 and 2 in the table, were raised from a cone gathered upon Mount Lebanon by Dr. Pococke, the celebrated oriental traveller. The seeds were sown in 1739. Two

only came up, and being planted out, remained stinted plants. They were transplanted to their present sites in 1767, being at that time about 17 inches in girth, at one foot from the ground. The other four trees were raised from a cone brought from Wilton House, the well-known seat of the Earl of Pembroke, in 1772, and were planted out where they now stand in 1778. A very healthy beech, transplanted in 1777, to a spot near these cedars, is of very inferior girth. The following table will afford a view of their progress and present condition.

	1787.	1799.	1812.	1827.	1832.	
No. 1. Cone from Lebanon, raised 1739, measured in 1777, 1. 10½	ft. in. 2 11½	ft. in. 4 11¼	ft. in. 6 10½	ft. in. 8 11	ft. in. 9 3½	3 feet from ground.
No. 2. Cone from Lebanon . .	1 10⅛	3 11	6 0½	7 10	8 6	Ditto.
No. 3. Cone from Wilton, planted out in 1778, next to No. 2		3 7	6 7½	9 4	10 0	Ditto.
No. 4. Cone from Wilton, opposite north-east angle of house, planted 1778		3 7½	6 6	9 6	10 2½	Ditto.
No. 5. Cone from Wilton, opposite south-east angle of house, planted 1778			6 6½	9 5	10 3	Ditto.
No. 6. Cone from Wilton, in the park, planted 1778				9 6	10 6	Ditto.

A second species of cedar (Pinus Deodara) exists in the Himalayan mountains. It attains to a great size, and in all ages has been regarded with great consideration by the natives of these countries: usually planted by them around the temples of their gods, it would indeed seem, from its name, (devadara or deodara, which means God's tree,) to be, in some measure, dedicated to that especial purpose. It bears some resemblance to the cedar of Lebanon, equals it in size, but, judging from some views of scenery in the Himalaya which we have seen, is, probably, of more aspiring habit. Seedlings have been raised in this country, and its hardihood has been ascertained by a specimen, several feet in height, which thrives in the open ground at Hopetoun House. As it can only be propagated from seed, we recommend this fine tree to the peculiar attention of individuals connected with the country of its growth.

Next in beauty to the cedar, as a park tree, we may, perhaps, reckon the SCOTCH FIR (Pinus sylvestris.) Nothing can well be uglier than a drawn-up grove of Scotch firs. A large, undulating, and sloping wood, consisting of this tree is, on the contrary, an object of striking beauty,—beauty indeed of a peculiar and sombre character, suiting well with heathy forest land of varied surface, and finely adapted to invest with an effect novel, and impressive in this climate, a lake entirely surrounded by such a wood. Some such effect of scenery may be seen around Virginia Water, in Windsor park. The Scotch fir is also fine as a single specimen, when it becomes broad and umbrageous, and tufted; or condensed into small groups composed of a few specimens only. But, upon the whole, we are of opinion that the most appropriate application of coniferous trees, in our climate, is not to intermix them with deciduous trees, but to assemble them into what has been appropriately called a Pinetum. This has been admirably done by Lord Grenville, at his beautiful seat, Dropmore. Such an evergreen quarter is an invaluable winter refuge. The individuals composing it are derived from many countries throughout the northern hemisphere;

they possess a geographical interest; they are of great and diversified value, for sundry economical purposes; they differ much in habit, hue, and general appearance. When all other trees are despoiled of their leaves, these, unscathed by the vicissitudes of the seasons, remain unchanged. In deciding upon the site of a Pinetum, attention should be given to the nature of the soil; for though pines, in their native places, grow sometimes in very poor soils,—from the crevice of the naked rock, on the barrenest hill side, or in the most sterile sands; here, where the natives of very different climates are assembled together by human enterprise and ingenuity, to contend with conditions differing much from those to which nature had originally submitted them, every compensation that is possible should be made. Shelter is indispensable,—many of the species are delicate,—variety of surface is desirable,—some prefer a less sunny situation than others; depth of soil is essential,—the last degree of vigour should be aimed at; a deep sandy loam is to be preferred, for almost all the species should be carefully guarded from stagnant moisture, and on a cold subsoil few will thrive. To describe in detail every coniferous tree, would be but to repeat what has been already done in this work. We shall pass them in review rapidly, glancing at those which are either new, neglected, or desirable to be added to our vegetable wealth.

Among the species most generally known, the silver fir and the Norway spruce fir are conspicuous. They are both of considerable beauty, pyramidal in form, of great size and bulk, and are sometimes very stately, when standing singly. The silver fir, in England much the largest tree, grows slower than the Norway spruce, during the first twenty years of its age, but then, continuing its growth with accelerated pace, passes it by rapidly. The balm of Gilead fir (Pinus balsamea), nearly allied to the silver fir, perhaps handsomer in foliage, is not worth planting. During the first years of its existence in England, it grows with sufficient quickness, but soon relaxes, becomes diseased, and dies. We are inclined to attribute its premature fate to the average summer temperature in our climate being insufficient to ripen its rootlets sufficiently; for the tree seems to die so soon as, in the natural progress of its growth, its roots have penetrated some depth beneath the surface. The white spruce of North America (Pinus alba) is sufficiently distinguished to merit a place in the pleasure-ground; it differs from the Norway spruce by the peculiar blue hue of its foliage. Pinus nigra and rubra, spruce firs of much humbler growth, are rather subjects for the Pinetum than for the park generally. A most magnificent tree, resembling a silver fir upon a large scale, (Pinus spectabilis,) has lately been introduced from the mountains of the Himalaya. Nothing in the fir tribe can easily surpass in beauty this fine tree, whose silvery bark, bright green leaves, white beneath, and purple cones, studded with drops of transparent resin, render it an object of high attraction. It grows to large size, and, in the south of England at least, is hardy, though, owing to the earliness of its spring growth, it will be liable to receive injury from frost. It is still exceedingly scarce in the nurseries, where it has been increased by cuttings, a mode of propagation ill adapted to produce a fine tree. Every exertion should be made to procure its cones; no matter of difficulty now that the British dominion has extended over the remotest recesses of the Himalaya.

We revert to the Norway spruce, so universally known, only to mention the vast mischief done by squirrels in plantations of this valuable tree, and to caution all planters against allowing these animals to multiply. In winter, when pressed by a deficiency of other food,

they bite off the smaller shoots over the whole surface of the tree, finding, apparently, at the gibbous base of the shoot made in the preceding summer, a small portion of pith; at least, we have never seen any but the shoot of one season's growth to be bitten off, and always to have been gnawed only at its base. Being astonished at the wide extent of the ravages committed by these animals, in a large plantation of spruces, scarcely a tree being untouched, we caused the shoots, which had been bitten off and were lying under one tree, to be collected. They filled two corn-sacks. The effect upon the specimen is extremely destructive to its beauty and its growth.

Among the firs long introduced among us is the hemlock spruce fir (Pinus Canadensis) a tree of vast growth in its native regions in North America, and of beauty so striking that we wonder it should still be rare in our gardens. In foliage it resembles the yew, but is of a light and cheerful tint, and is free from that rigidity of habit, which is the general fault of the trees of that section of the genus Pinus, which bear solitary leaves, and are generally called firs in contradistinction to the pines, which bear their leaves in distinct sheaths, enveloping more or less crowded fascicles. A most interesting fir of this section has been recently introduced into this country by the indefatigable collector of the Horticultural Society of London, Mr. David Douglas, from the north-western regions of North America, where it is found abundantly between the rocky mountains and the Pacific ocean. Pinus Douglasii, which is, perhaps, the Pinus taxifolia of Menzies, is a stupenduous tree, growing from 150 to 200 feet in height. One specimen is said, by a traveller upon the Columbia, to have measured 230 feet in height, and fifty feet in circumference. Its timber is singularly close-grained and heavy, its bark surprisingly thick, its foliage very elegant. It is quite hardy, and apparently of rapid growth. Judging from the appearance of young specimens, we deem it the most lovely of its class yet known to us. Reverting to the section, the leaves of which, like the Scottish fir, are borne in sheaths, we must mention another fine hardy tree, brought from the same regions by the same distinguished traveller, Pinus ponderosa, so named from the great specific gravity of its valuable wood. It appears to resemble the Scotch fir in habit, has longer leaves, grows rapidly, but is understood not to arrive at the gigantic stature of Pinus Douglassii. Its wood is singularly close in the grain, and of great durability, probably excelling in value that of any other species of the whole tribe; and as it appears to us to grow as fast in this climate as the Scotch fir, we are inclined to think that it ought everywhere to supersede that species. But as the whole of the individuals among us were probably raised from the cones imported by Mr. Douglas, a fresh importation is a most desirable matter, to which we invite the attention of the public. A tree well known to the Romans (Pinus Laricio) has lately travelled to our collections from the mountains of Corsica. Though its native habitation was so near to us, it had entirely escaped the notice of British collectors, till the overthrow of Napoleon introduced to them a specimen thriving conspicuously in the arboretum of the Jardin des Plantes at Paris. Since then it has been raised in considerable numbers in some of the London nurseries. It is a native not only of the mountains of Corsica, but of the loftier summits of the Grecian archipelago, and has been found upon Mount Ida. Handsomer when young than the Scotch fir, it is equally hardy, has longer and finer foliage, is of more elegant habit, produces timber of greater specific gravity, and is very deserving of the marked attention, not only of the ornamental planter, but also of the planter for

profit. Another very interesting tree from the East, introduced into the country about twenty years ago,—Pinus Pallasiana,—has been better known by the name of Pinus Taurica. In the central regions of the Crimea, on the western declivities of the mountains, which stretch along the shores of the Black Sea, this tree, called *tzaam* by the natives, forms considerable forests, and grows to a great size. Its wood is very knotty, resinous and durable, but is not well adapted to the purposes of the joiner, on account of the knottiness of its texture. It throws out its branches, almost from the base of its trunk, in a horizontal direction, and is said to be strikingly picturesque in its habit. It abounds with a resin singularly odorous, and will probably be one of the most distinguished inhabitants of the Pinetum. But the experience of Mr. Lambert has assigned to this tree a station of singular utility. He has ascertained practically its capacity of flourishing upon the most barren chalk downs, where the thinness and aridity of the soil combine to forbid almost every other tree from succeeding. A few trees which he planted at Boyton about twenty years ago, where the soil was little more than two inches thick upon a bed of hard chalk, are now nearly thirty feet high, and very luxuriant. Many were planted by the present Duke of Marlborough at White Knights. Their cones produced in this country have never perfected seeds, but it cannot be difficult to procure them from the Western Coast of the Crimea. It may be as well to remark here, that in bringing home cones of any fir, peculiar care should be had in placing the box containing them, in an airy situation, in the cabin or between the decks. The high temperature and confined air of the hold of the ship destroy the life of seeds speedily. A very magnificent pine was discovered by Mr. David Douglas in sandy plains in Northern California, and appropriately named Pinus Lambertiana, in honour of the very distinguished botanist, Aylmer Bourke Lambert, Esq., whose magnificent work on the Genus Pinus, to which we have been largely indebted, has contributed in a remarkable degree to elucidate the history of this extensive genus. It is a plant of vast size, growing in its native plains from 150 to 200 feet high: one specimen which Mr. Douglas measured was 215 feet in length, and 19 feet in diameter. The cones of this splendid tree are sixteen inches in length and nine inches in circumference. We apprehend, from some observations which we have made, that in Great Britain it can only be regarded as a specimen tree, confined to very sheltered and warm spots. But the recent and still-pending researches of the same enterprising traveller and enthusiastic botanist, in the same regions of North America, the regions which bound the Northern Pacific Ocean, bid fair to enrich the Pinetum in no common degree. In the mountain valleys of the Alps of New Albion, surrounded by snow peaks exceeding Mont Blanc in elevation, he has lately discovered several most interesting species, which must all be hardy in England:—Pinus nobilis, and Pinus grandis, equalling Pinus Lambertiana and Pinus Douglasii in hugeness of stature; Pinus monticola, two varieties, resembling in elegance of foliage the Weymouth pine; Pinus Menziesii, of smaller growth, but curious habit; Pinus Sabiniana,—are all plants of great interest, and will be acquisitions of uncommon value. We suspect that mountain trees, from elevations correspondent in temperature with the climate of Britain, will be found to succeed in it better than trees from lower regions, even when situated more northerly. The larch of Switzerland and the Tyrol countries, to the south of us, succeed better here than the larches of Siberia and Canada. The Pinus Laricio of the mountains of the genial countries of the Mediterranean is more at home in England than the

Pinus balsamea of Nova Scotia; and it may be expected that the trees of North Western America will do better with us than the trees of correspondent latitudes in the United States, where the extremes of summer and winter temperature are more violent than in the countries bordering on the Northern Pacific Ocean.

In treating of garden trees, we have omitted to mention Pinus cembra. Even in its native climate and soil, among the mountains of Switzerland, it is remarkable for the slowness of its growth, and in England the Swiss variety preserves the same character; but it is also indigenous to Siberia; and we have observed that the Siberian variety, which is not uncommon in our nurseries, makes less rapid progress than its Swiss congener. Pinus cembra, when it has attained to considerable size, is one of the most ornamental trees of the whole tribe, and should find a place upon every extensive lawn.

It would be superfluous here to discourse upon trees so well known as the larch, whose wood almost rivals the oak in durability, and whose bark is about half the value of the bark of that tree; of the Weymouth pine, whose stem furnishes masts; of the Stone Pine, whose vast canopy, supported upon a naked column of great height, forms one of the chief and peculiar beauties in Italian scenery, and in the living landscapes of Claude; of the pinaster, whose clustering cones and fine foliage entitle it to rank high among the most picturesque of its congeners; of the Mugho pine, and Pinus pumilio, whose low dwarfish growth are of great value in the picturesque arrangement of a Pinetum. There are several other species, which, though neither of size nor of beauty to entitle them, in this brief sketch, to a distinct notice, should be included in the range of a well-ordered collection. We shall, however, pause a moment to advert to Pinus excelsa and Pinus Gerardiana, both lately introduced from the regions of the Himalaya. The former is a tree of large size, growing from 90 to 120 feet high; the latter a fine tree, said to resemble the Stone Pine, and known to the natives by the name of the Neoza pine, produces an abundance of edible seeds. Several other species exist upon the Cordillera of the Andes, stretching from the northern side of the equator, through Mexico to New Albion, and at intervals rising into the region of eternal snow; some perhaps upon the mountain chains of Caucasus and of Central Asia. A few coniferous trees of other genera remained to be mentioned. A noble tree of most exotic appearance (Auraucaria imbricata) graces the more southerly plains of South America, and with slight protection endures the climate of the south of England. Another species of too tender constitution (Auraucaria Brasiliensis) is supplied by Brazil; others exist upon the shores of Australia: the noblest of all, and the fairest (Auraucaria excelsa), whose beauty and stateliness are faintly represented by a few specimens confined within the narrow limits of our conservatories, is found, exclusively we believe, in Norfolk Island, one of the loveliest spots in the southern hemisphere, (the penal station of the penal colony of New South Wales), where it rises to the magnificent height of more than 200 feet, and reaches to bulk correspondent with so vast a height. A very pretty tree, nearly allied to Auraucaria,—Cunninghamia lanceolata, —is becoming general in collections. It is a native of China, and hardy in light soils. Being always in this country propagated from cuttings, it requires some management to make it throw up a vigorous leader, and assume the habit of a tree. If, however, it be planted out in a sheltered situation, and in good soil, and if then, when it shall have made a considerable mass of roots and is well established, its shoots be depressed into a horizontal position, and so confined with pegs, it will ultimately

throw up a strong perpendicular shoot from its roots, and make quick progress. Sometimes these strong shoots, after a year or two of rapid growth, relax their speed, and discontinue the function of a leader: in such cases they must be depressed as before, and the practice will be sure to succeed at last.

The Italian cypress (Cupressus sempervirens), so conspicuous and so beautifully applied in the terraced scenery of Italian villas, cannot be said to attain to full vigour even in the south of England. It is essentially the tree of architectural gardens, and ought never to be forgotten when the climate and soil admit of its application. A tree nearly allied to it, but deciduous (Cupressus disticha of our enumeration), now separated into a distinct genus, under the name of Taxodium distichum, is one of the largest and most ornamental of all the trees which thrive in temperate climates. Nothing can well surpass the loveliness of its light and delicately-coloured foliage. Though a native of Mexico, and of the southern sections of the United States, inhabiting the deepest deposits in the valleys of their vast rivers, and luxuriating in the deadly swamps of the Mississippi, yet in England it appears to be perfectly hardy,—affording one of many instances, that trees vary in hardihood of constitution, and are not to be absolutely tested by the latitudes, or even by the elevations, where nature has originally placed them. It should have a deep, and, if possible, humid soil. When we say that no pleasure-ground should be without it, we but faintly express our sense of its elegance. Another species of taxodium (Taxodium sempervirens), an evergreen tree, exists on the North-Western shores of America, and should be introduced into this country. One, if not two, true species of cypress are known to be found on the same shores. In China and Japan several species of conifera are among the most remarkable characteristics of their vegetation. Cupressus pendula, which equals the weeping willow in the charms of its pendant branches, in China is generally planted to hang over the tombs of the departed. Nothing can be better in unison with this purpose than the dark and weeping branches of this tree. Several species of thuya, inhabitants of the same countries, are great desiderata. Among them, Thuya dolabrata calls upon us for the most earnest endeavours to introduce it. This plant is described by Kæmpfer and Thunberg, who saw it in its native soil, as a lofty, vast, and beautiful tree, of all evergreens the fairest. It is unquestionably hardy. The policy of these remarkable nations opposes the most inflexible resistance to European intercourse. Still the perseverance of individuals, and of the Horticultural Society of London, have procured us many of their beautiful plants. The camellia is the chief spring ornament of our conservatories; their magnolias, their azaleas, their pæonies, decorate our pleasure-grounds; the corchorus and the numerous varieties of the china rose, adorn our humblest cottages; but scarcely a forest-tree has yet taken its station upon our lawns. We cannot doubt that this may also be achieved. To China, to Japan, to the Himalaya, and other mountain chains of Central Asia,—to the alpine vallies of North-Western America,—to Patagonia, the hills of Southern Chili, and the archipelago of Chiloe,—we look as to the sources almost unexplored of additional wealth to the arboretum. Our intercourse with almost every corner of the habitable globe is so intimate, communications with the most distant nations are so frequent, so many accomplished individuals inhabit countries the most remote, that we are persuaded it is only necessary to invite general attention to our favourite object, in order to place it in a fair train for accomplishment.

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